AVIATION WEEK

A McGRAW-HILL PUBLICATION

October 29, 1956 50 cents

Piper Broadens Model Line to Meet Sales Goal

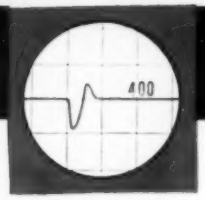
Saab 35 Drakens

Aerodynamic Heating Taxes Test Ingenuity

Supersonic, Space Flight Simulated

First in Constant Speed Drives...

SUNDSTRAND



New electrical concept in F-102A attributed to Sundstrand Constant Speed Drives

The advanced Air Force F-102A all-weather supersonic interceptor, built by Convair, incorporates the new concept in electrical systems. Here, due to the Sundstrand Constant Speed Drive, is an automatic constant frequency a-c system providing plenty of stable power, with heavy overload capacity under all flight conditions. Here is reliable power for optimum operation of electronic devices which make the F-102A a modern, integrated, all-weather weapon. And here is another example of how the new concept in electrical systems . . . fostered by Sundstrand's Constant Speed Drive . . . meets the challenge of today's . . . and tomorrow's . . . fast, high-flying jet aircraft. Can we help you?

New Electrical Horizons . . .

are opening to design engineers, through co-operation between engine and airframe manufacturers and Sundstrand. With this new concept in electrical systems, expect remarkable advances in operation and performance of tomorrow's aircraft.

SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company, ROCKFORD, ILLINOIS Western District Office: Hawthorne, California

CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES

DOUGLAS
and
GOODYEAR
teamwork
results in 3 important "FIRSTS" and important weight-savings for the "Seven Seas"!
• FIRST production airplane to use Tri-Metallic Brakes
• FIRST commercial transport to be delivered with tubeless tires
• FIRST commercial transport to use forged magnesium wheels

In a 5,000-mile flight, each pound saved takes on added significance—and three weight-saving pieces of Goodyear equipment contribute importantly to the success of the new Douglas DC-7C's range and revenue as an overseas carrier.

First, the DC-7C specified Goodyear Tri-Metallic Brakes to take advantage of the weight- and space-savings that result from this new brake design, which gives up to 50% more kinetic energy absorption per pound of brake.

Second, these main wheels are equipped with Goodyear Tubeless Tires—eliminating tube weight, simplifying inventory and insuring topmost performance, thanks to Goodyear's exclusive 3-T Nylon construction.

Third, main wheels of forged magnesium by Goodyear were selected as original equipment because of their record capacity per pound, greater roll life, absence of fatigue "footholds"—and weight-savings of 15% over conventional cast magnesium wheels.

The DC-7C typifies Goodyear's ability to engineer the complete package—tires, wheels and brakes—with outstanding results.

The confidence placed in these skills is found in this simple fact:

More airplanes land on Goodyear tires, wheels and brakes than on any other kind.

Goodyear, Aviation Products Division
Akron 16, Ohio, and Los Angeles 54, California

FACILITIES + ABILITIES = EXTRA *plus* IN PERFORMANCE

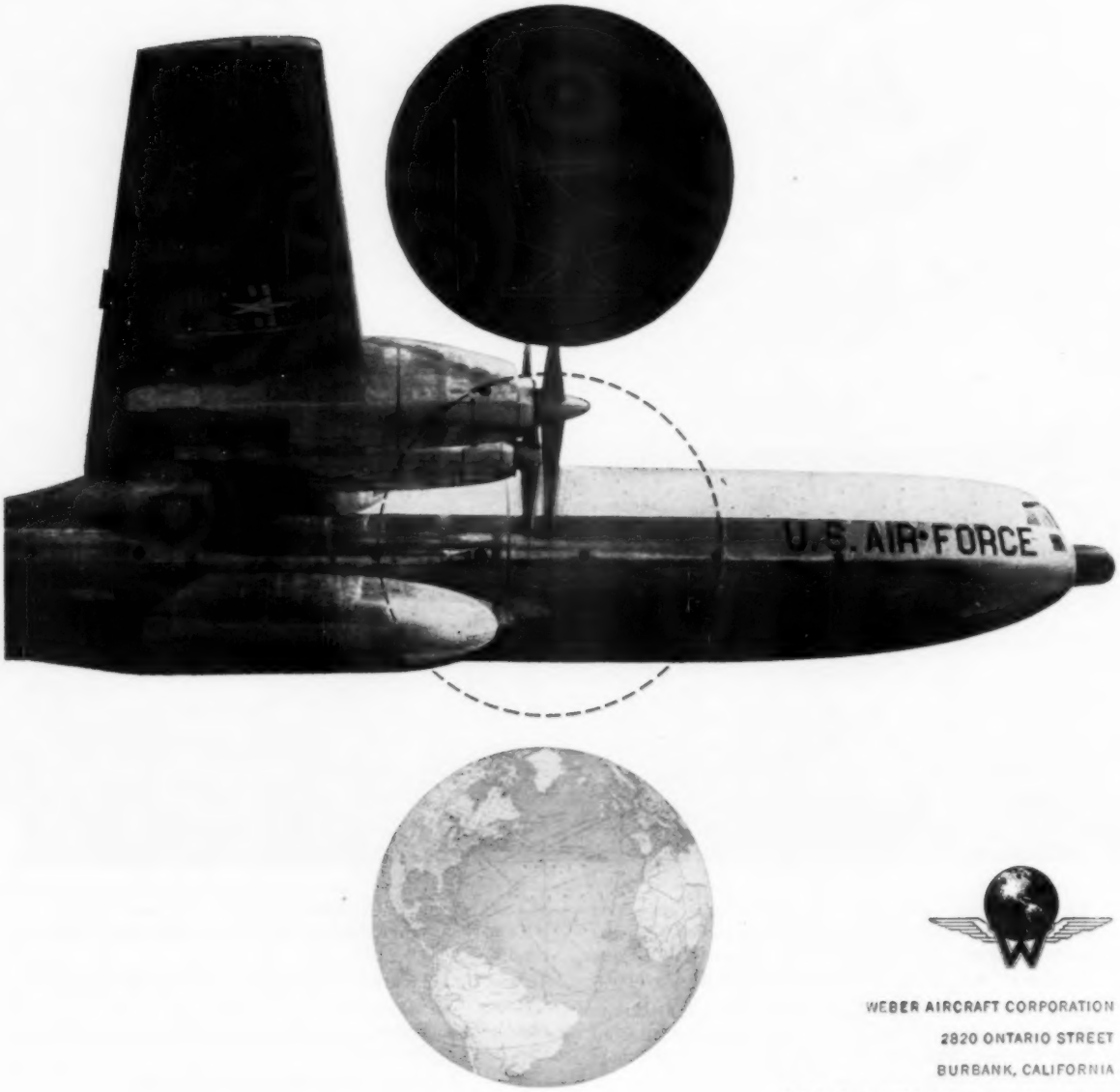
GOODYEAR AVIATION PRODUCTS

The Douglas C-133A

is a giant among cargo carriers.

Navigator seats for these behemoths

are designed and built by Weber.



WEBER AIRCRAFT CORPORATION

2820 ONTARIO STREET

BURBANK, CALIFORNIA

A Subsidiary of Weber Showcase & Fixture Co.

AIRCRAFT INTERIOR EQUIPMENT

(SEATS, BUFFETS, LAVATORIES)

GROUND HANDLING EQUIPMENT

ELECTRONIC SYSTEMS

AIRCRAFT SUB-ASSEMBLIES

466

ADVERTISING DESIGNERS CO.

AVIATION CALENDAR

Oct. 29-31—Air Traffic Control Assn., First Annual Convention, New Colonial Hotel, Washington, D. C.

Oct. 31-Nov. 1-2—1956 Annual Meeting and Exhibit, Society for Experimental Stress Analysis, Deshler-Hilton Hotel, Columbus 1, Ohio.

Nov. 1-2—20th Anniversary National Time and Motion Study and Management Clinic, sponsored by Industrial Management Society, Sherman Hotel, Chicago, Ill.

Nov. 12-15—Thirty-Sixth Annual Meeting, American Petroleum Institute, Hotels Conrad Hilton, Palmer House and Sheraton Blackstone, Chicago, Ill.

Nov. 13-14—Sixth Transport Aircraft Hydraulic Conference, sponsored by Vickers, Inc., Park Shelton Hotel, Detroit.

Nov. 14-16—Symposium on Optics and Microwaves, sponsored by the Institute of Radio Engineers Professional Group on Antennas and Propagation, Lisner Auditorium, George Washington University, Washington, D. C.

Nov. 14-16—Latin American Aviation Conference, sponsored by Export Committee, Aircraft Industries Assn., Miami, Fla.

Nov. 14-16—Jet Engine Overhaul Symposium, General Electric Co., Evendale, Ohio.

Nov. 15—Conference on problems and issues concerned with control and protection of airport approaches, sponsored by Institute of Transportation and Traffic Engineering, University of California, International House, University of California, Berkeley, Calif.

Nov. 15-16—Guided Missile Branch and Committees, American Ordnance Assn., Naval Ordnance Test Station, Inyokern, Calif.

Nov. 15-16—Metropolitan New York Material Handling Conference, sponsored by N. Y. Chapter of the American Material Handling Society, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

Nov. 16-17—Air Mail Pioneers Eastern Division Reunion, Ambassador Hotel, Washington, D. C.

Nov. 25-27—Aviation Distributors & Manufacturers Assn., 28th Meeting, Drake Hotel, Chicago, Ill.

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Vol. 65, No. 18

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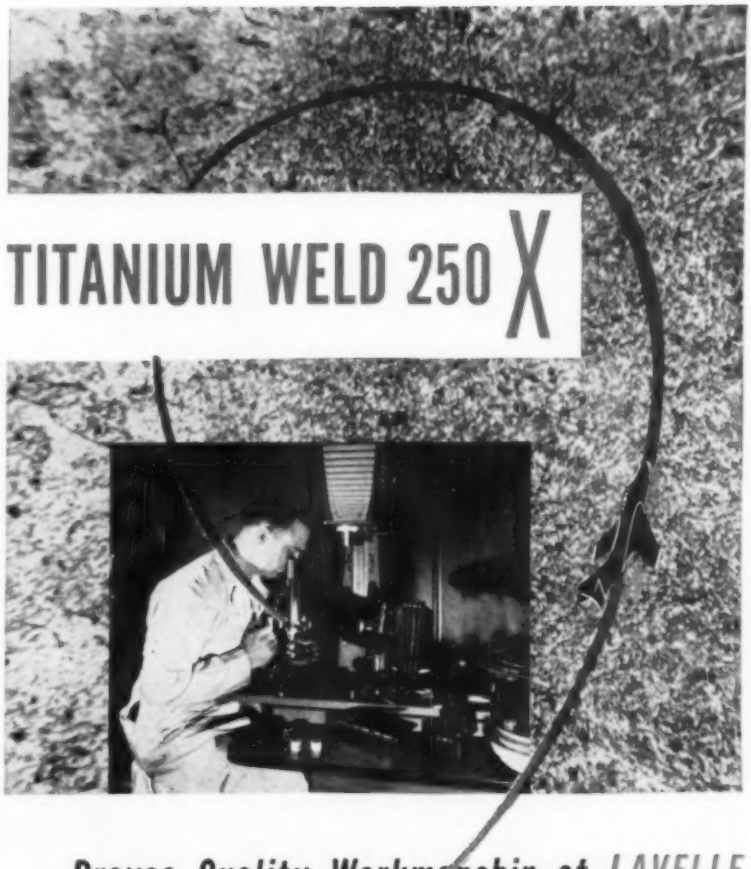


TITANIUM WELD 250X

. . . Proves Quality Workmanship at LAVELLE

The microscopic inspection equipment and actual photomicrograph of a titanium automatic heliarc butt weld 250x, shown above, are typical of the quality control techniques employed by Lavelle to assure *production perfection* of critical parts and components for the aircraft industry.

Advanced facilities and methods for welding titanium and high temperature nickel and steel alloys . . . Government Certified technicians and equipment . . . *plus* careful inspection and follow-through by experienced specialists at every stage of production, add up to greater speed, efficiency and economy in meeting customers' exacting specifications at Lavelle.

Learn how this *complete* service proves the quality workmanship of the precision components you require . . . when you call on Lavelle for your fabricating needs.

Additional data on Lavelle's specialized fabricating services is contained in this illustrated brochure. Write for a copy without obligation.

Lavelle

LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.

Between Philadelphia, Pa., and Trenton, N. J.

DOW

Dow high temperature magnesium alloys have excellent fabrication characteristics

Lightweight structural metals with high strength, stiffness and elasticity at elevated temperatures! A new group of Dow magnesium alloys offers a great combination of these properties without the fabricating difficulties normally experienced with other high temperature materials.

Specially developed for use in airframes, missile and engine structures, the new alloys are already making weight reductions possible for several manufacturers. These alloys show advantages at temperatures up to 700°F. Limited test data on properties up to 800°F. are available for some of them.

FABRICATION: Fabrication characteristics are equal to those of standard magnesium alloys.

WELDABILITY: 95 to 100% weld efficiency at elevated temperatures.

FORMABILITY: Single deep draws can be easily accomplished.

MACHINABILITY: Best machining characteristics of any structural metal.

One of the new alloys is magnesium-thorium composition HK31A. It is now available in rolled form from stock. Castings and sheet in mill quantities are also readily available. A companion alloy for extruded shapes and forgings will soon be in production.

For more information about the new high temperature magnesium alloys, contact your nearest Dow Sales Office or write to THE DOW CHEMICAL COMPANY, Magnesium Sales Department MA 362G-1, Midland, Michigan.

EASILY FORMED. These HK31A parts were drawn using production dies and processes for standard magnesium alloys. The parts retained a higher percentage of original properties than standard alloys.

you can depend on DOW MAGNESIUM DOW

Production Line Experience Proves the Consistency of New Sciaky Electronic Weld Control

First reports from aircraft industry manufacturers are unanimous in their recognition of the absolute weld consistency and positive reproducibility provided by the new Sciaky Predetermined Electronic Counter controlled welders.

Users say that, for the first time, it is now possible to get *precisely* what they set on the welder. The machine cannot deviate from its setting. It is consistent throughout the entire range of adjustment. And set-up to repeat previous production runs is simple and positive.

How It Works

Without deviation, the new Sciaky control counts the cycles of power line frequency which is governed by the U.S. Naval Observatory. In predetermined absolute numbers, cycles and impulses are simply counted by a Dekatron tube to control the duration of various welder functions.

Single Tube Handles All Succeeding Functions

A single tube is used to count both the respective cycles of succeeding functions as well as impulses of welding current. For example, only one Dekatron tube is used to count respective cycles of squeeze, weld, hold and off and in respective impulses, preheat, weld and postheat. A second Dekatron tube is needed only for simultaneous functions, such as cool, heat, and current decay.

All control dials for timing functions are calibrated in cycles, while all control dials for interval functions are calibrated in impulses of secondary current. No involved second-to-cycle calculations are required for welder set-up.

Simple Maintenance

Plug-in sub-assembly control units minimize maintenance down-time. Replacement of a sub-assembly is only a matter of minutes.

The absolute consistency of the control eliminates the need for time consuming periodical check-out or calibration.

Future applications of the machine that may require additional welder functions won't obsolete the welder. The plug-in sub-assembly feature permits easy addition of preheat, quench, postheat, etc.

Data Available

More complete information on operation and control combinations available with Sciaky Predetermined Electronic Counter controlled welders is given in Sciaky Bulletin No. 339. Copies are available on request.

At regular intervals Sciaky will present reports of jobs being done on Predetermined Electronic Counter controlled welders. Look for them in leading aviation industry magazines.

PMM 2 STK 125 KVA ROLL SPOT AND SEAM WELDER with Predetermined Electronic Counter Weld Control.

Largest Manufacturers of Resistance Welding Machines in the World

SCIAKY®

Sciaky Bros., Inc., 4935 West 67th Street, Chicago 38, Ill., Portsmouth 7-5600

new airliner makes most of THIS space-saving design

CAPITAL AIRLINES is proud of its spanking new turbo-prop Viscounts. The finest aeronautical and electronic know-how has been employed in the development of this inspiring new airliner.

This advanced thinking is apparent, too, in the Viscount's air conditioning system. For the heart of the system they selected a Joy AXIVANE Fan . . . and used to full advantage the inherent space-saving characteristics of this unique *in-line* fan design.

Because Joy AXIVANE Fans can be installed *in the duct*, they may be located in any part of a plane that has ducting. Light-alloy magnesium and aluminum construction save weight but give the greatest vibration-resisting and shock-resisting strength.

FROM 20 CFM TO OVER 6000 CFM is the range of ratings of Joy AXIVANE Aircraft Fans . . . in weights from 10 ounces to 50 pounds. Joy Axivane Aircraft Fans are working, today, in Grumman, North American, Douglas, Martin, and Sikorsky Aircraft. You can put them to work in yours, too. For details write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 124-59

ALL JOY AXIVANE AIRCRAFT FAN DESIGNS ARE BUILT TO CONFORM TO ARMY AND NAVY SPECIFICATIONS . . . WITH OVER 90 STANDARD MODELS AVAILABLE IN A LARGE RANGE OF PERFORMANCE . . . CUSTOM DESIGNS AVAILABLE ON REQUEST.

Consult a Joy Engineer

WSW A-6248-124

JOY

WORLD'S LARGEST MANUFACTURER OF VANE-AXIAL FANS

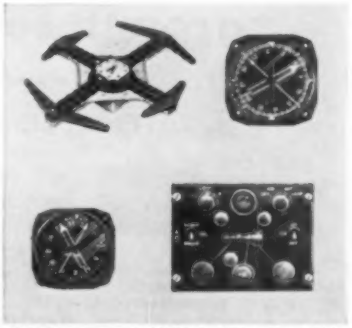
NOW THE DFA-70—SMALLER, LIGHTER WITH GREATER ACCURACY, HIGHER SENSITIVITY

Here's another big advance in automatic direction finders from Bendix . . . the all-new DFA-70 system. It provides greater accuracy and higher sensitivity that make possible ±2 degrees bearing accuracy with input signals as low as 12.5 microvolts.

Only ½ ATR, the DFA-70 utilizes subchassis construction for simplified maintenance. Electrical tuning with digital indication eliminates tach shafts and permits the control panels to be located as far as 50 feet from receiver. Sense lines up to 35 feet can be used or up to 60 feet with slight modification. Other outstanding features include narrow-band Consol reception, ARINC Class I ruggedized tubes throughout, and new circuitry that minimizes precipitation static.

Bendix ADF has been the "standard of the industry" since radio direction finder equipment was first introduced. From the MN-26/MN-31 to our present DFA-70 system, Bendix has pioneered and developed most of the advancements in automatic direction finding navigation systems.

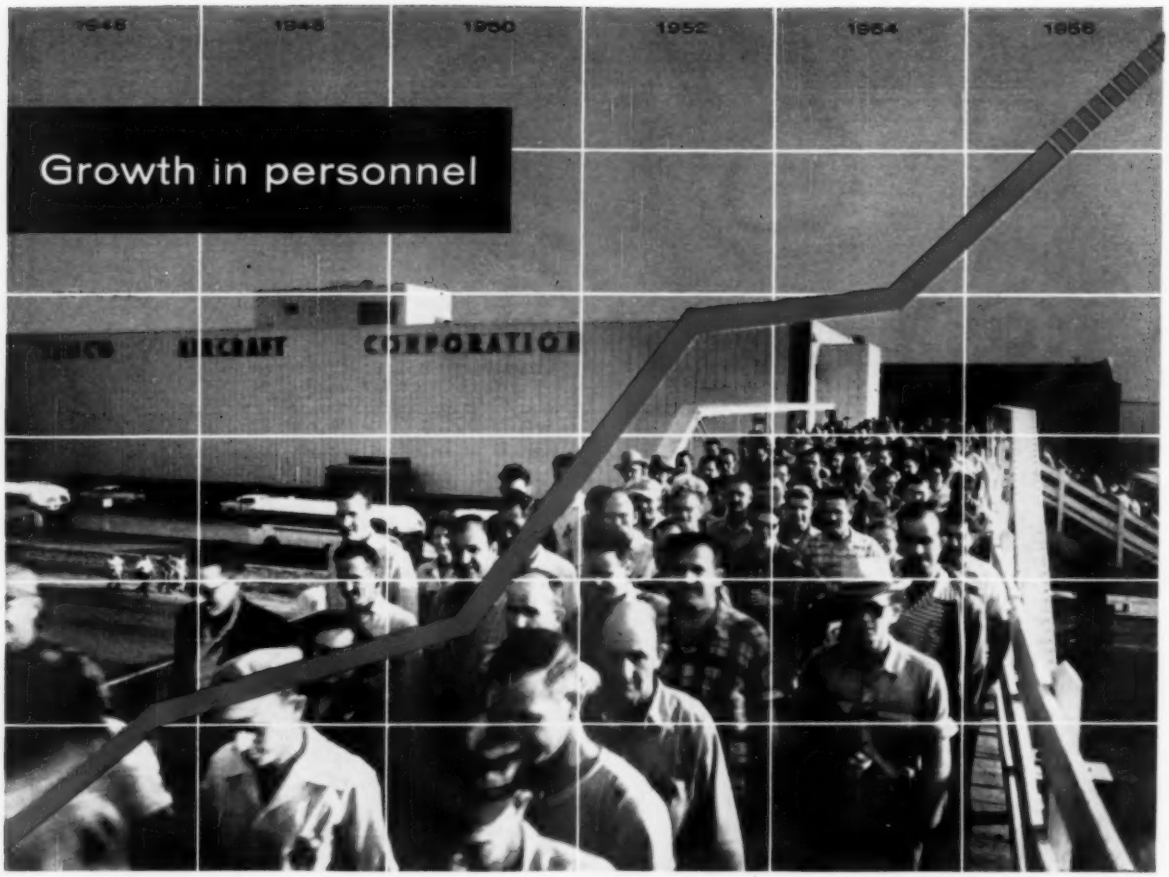
For complete information and specifications about DFA-70, write Bendix Radio, Aviation Electronic Products, Baltimore 4, Maryland. Or contact: West Coast—Bendix Radio, 10500 Magnolia Boulevard, North Hollywood, California; Export—Bendix International, 205 East 42nd Street, New York 17, New York.



DFA-70 components (clockwise from upper right): MN-72 Radio Magnetic Indicator, CNA-70 Control Panel, MN-58 Dual Azimuth Indicator, LFA-70 Flush Loop Antenna.

Bendix Radio Division

Bendix
AVIATION CORPORATION



At TEMCO growth tells the story!

Growth — in personnel, for example, tells the Temco success story.

In 1945, Temco had 259 employees. Today, Temco has over 10,000 employees — at three integrated Texas plants — at work on contracts covering fourteen of the country's key military aircraft. Constant expansion in every department has equipped Temco to meet the increasing needs of the aircraft industry—to push ahead the company's own developments in electronics and in aircraft and weapon systems.

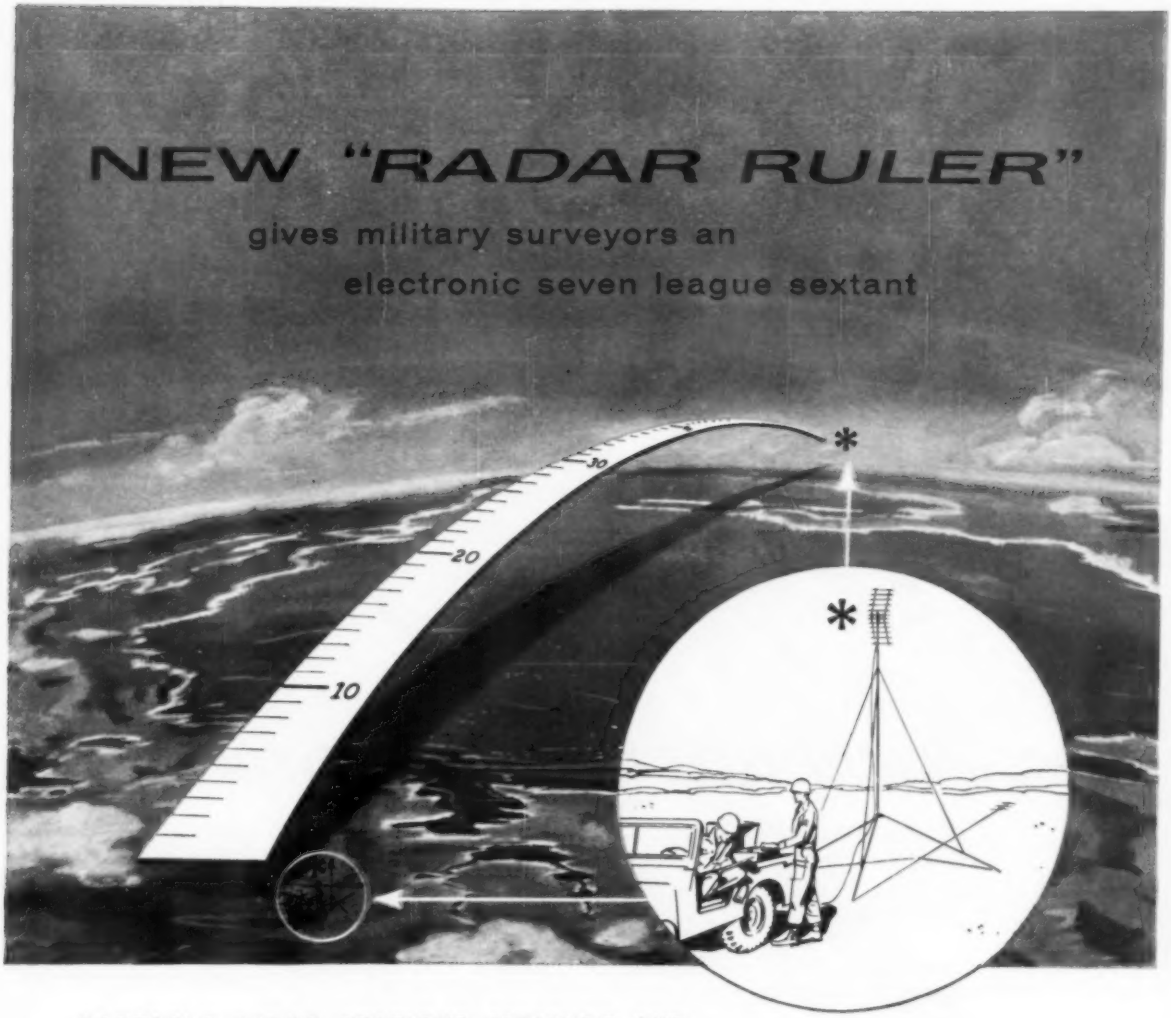
Temco's sturdy growth — in skills, facilities and experience — opens up outstanding opportunities for a complete range of engineering talents. If you are looking for a rewarding career in aviation, you will find it at Temco.

ENGINEERS

Openings in all phases of aircraft design and development. Write to Joe Russell, Engineering Personnel, Room 10-A, Temco Aircraft Corporation, Dallas, Texas.

TEMCO®
AIRCRAFT CORPORATION, DALLAS

IN ENGINEERING THE BEST OPPORTUNITIES ARE IN AVIATION • IN AVIATION THE BEST OPPORTUNITIES ARE AT TEMCO



PORTABLE RADAR STATIONS MEASURE AND DOUBLE CHECK 50 MILE READINGS IN SECONDS

For the *first time*, surveyors are freed from short-sighted optical equipment. Unlike old-fashioned surveying tools, the "radar ruler" pierces through fog, darkness or dense foliage, electronically pacing off distances of 1 to 50 miles, precise to within a few meters!

This new general-purpose surveying instrument was developed by Motorola's Military Electronics Laboratory for the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. The entire operation can be handled easily and quickly by unskilled personnel.

This self-calibrating system uses two identical portable radar stations which bounce a signal back and forth thousands of times each second. High-speed computers automatically provide the data necessary to measure off the distance.

Here is just one more example of the equipment now being developed by Motorola for many varied military applications.

3 suitcases and a 25 ft. collapsible antenna comprise the entire equipment

navigational devices • radar • countermeasures • microwave systems • communications equipment
data transmission • plotting systems • telemetering • data processing and presentation indicators

Positions open to qualified Engineers and Physicists

MOTOROLA *Communications & Electronics Division*
National Defense Department
2710 N. Clybourn Ave., Chicago, Ill. Other facilities: Phoenix, Arizona and Riverside, California

Rocket Powered Targets for Pushbutton Marksmen

Realistic targets for today's advanced weapons systems must be as fleet and maneuverable as the potential opponents they simulate. Small, speedy, remotely controlled drones can give pilots and gunnery crews the combat training they require.

Powerplants to propel drones at transonic and supersonic speeds represent another important area for the application of the advanced technology resulting from *RMI POWER ENGINEERING.*

Rocket power to drive missiles and piloted aircraft higher and faster has been the prime product of RMI since its inception 15 years ago. Today, as the oldest company in the rocket engine field, Reaction Motors has a wealth of experience gained in the design and production of engines for record-holding vehicles of both types.

Engineers and Scientists: creative and rewarding opportunities exist for all types of technical specialists in the research, development and production of rocket power devices. Send complete resume and salary requirements to employment manager.

PRIMARY AND AUXILIARY ROCKET POWER FOR: Missile Boosters and Sustainers, Aircraft, Target Drones, Ordnance Rockets, Ejection Systems, Launching Devices.

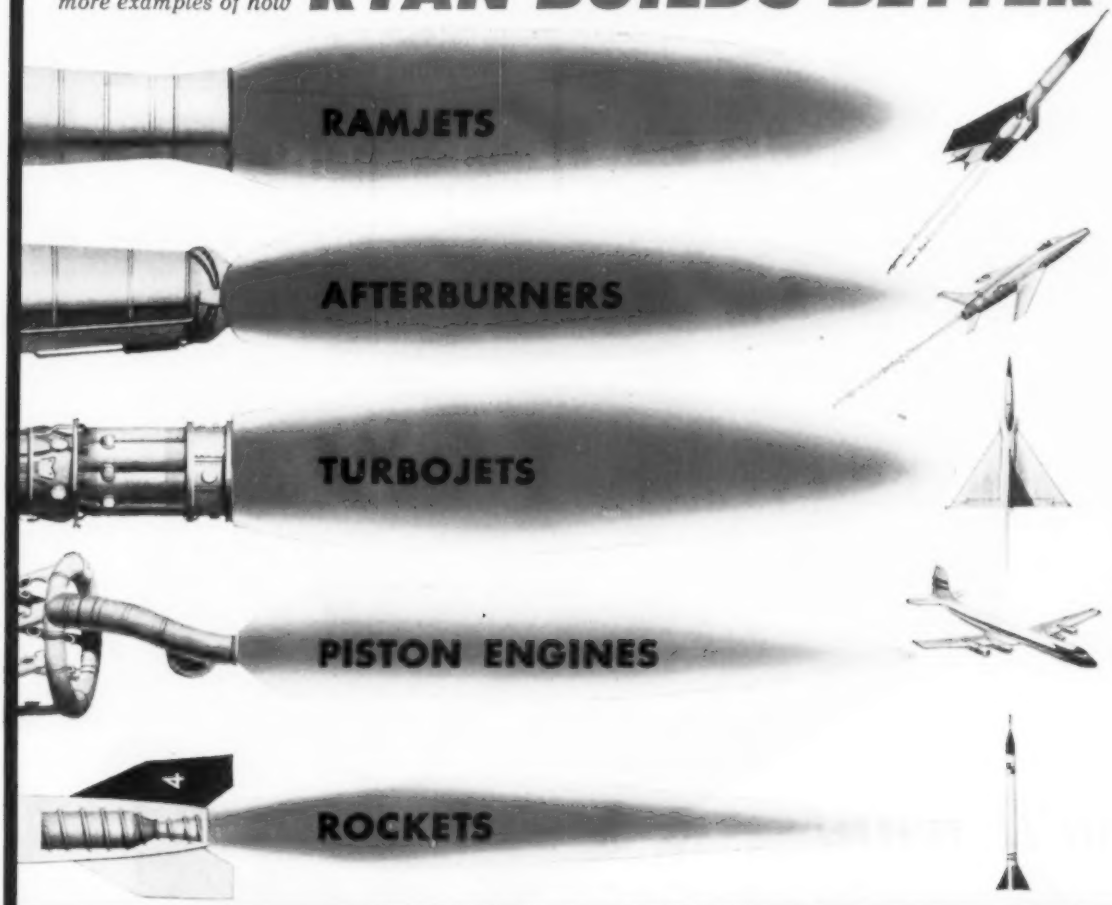
Power for Progress

REACTION MOTORS, INC.

A MEMBER OF THE OMAR TEAM

DENVILLE, NEW JERSEY

more examples of how **RYAN BUILDS BETTER**



HOT PARTS TO HURDLE THE THERMAL BARRIER

High speeds in flight mean high temperatures—up to 5000°F! In this new region of intense heat where ordinary metals melt like butter, Ryan metallurgists are pushing back thermal barriers with every new design. And Ryan production experts are *building* the hottest, fastest hot parts demanded by modern aviation.

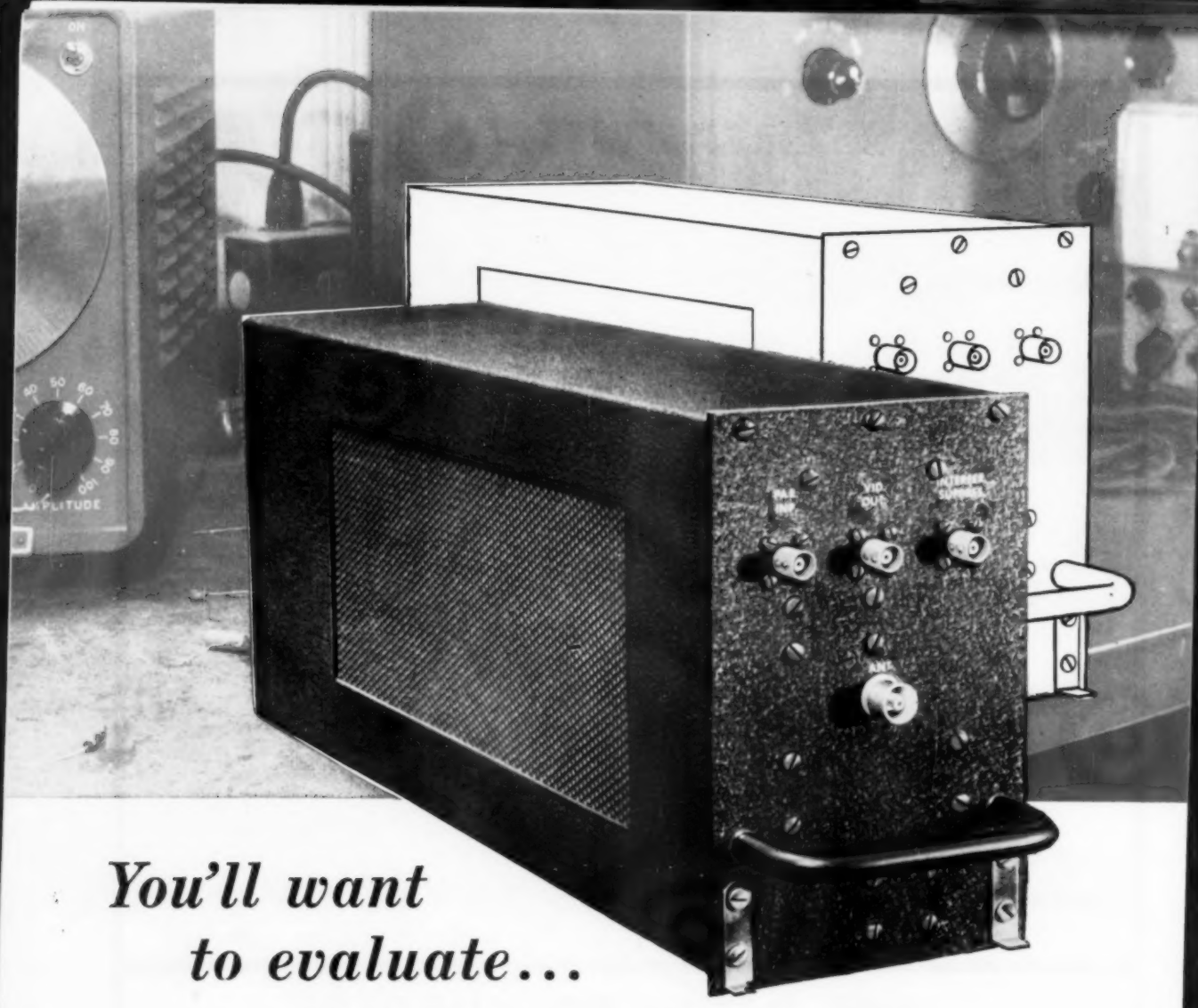
Ryan is uniquely skilled and equipped in this important field—able to draw upon its extensive stockpile of experience in the design, research and production of major high temperature jet age items. Dramatic proof of Ryan's leadership shows up on the production lines where ramjets, afterburners, turbojets, piston and rocket engine assemblies are precision manufactured, in quantity, to the highest quality standards.

BUILDING AVIATION PROGRESS SINCE 1922

Aircraft • Power Plants • Avionics

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIF.

Ryan



You'll want to evaluate...

...the new Stewart-Warner Electronics ATC Radar Safety Beacon on your own test bench.

Every Airlines Electronics Engineer who has seen the new airborne beacon is making plans to dig into this clean box on his own test bench. There will soon be a limited few units available for your evaluation study.

We want you to see for yourself how this equipment, specifically designed to ARINC characteristic No. 532-A, combines all the reliability and long-life factors of airborne radar equipment manufactured by Stewart-Warner Electronics for the past 15 years.

STEWART SW WARNER ELECTRONICS

a Division of Stewart-Warner Corporation

MOST ADVANCED DESIGN AVAILABLE

Stewart-Warner transponder experience has enabled us to evaluate possible future modifications in this type equipment. As a result, the design is flexible enough to accommodate all AEEC "Green Sheet" expansions; for example, side lobe suppression and other foreseeable requirements such as:

1. By internal switching we can provide a second pulse train spaced 4.35 microseconds after the last pulse of the first train.
2. The delay line is tapped every 1.45 microseconds to provide for future expansion of the coding system. For example, automatic air-to-ground flight data transmission.
3. Facilities have been provided to include two additional interrogation modes upon customer request.

Write today for latest details and availability of evaluation units. Stewart-Warner Electronics, Civil Aviation Dept. 14, 1300 No. Kostner Ave., Chicago 51, Ill.

THIS IS FOR YOU ... IF YOU HAVE AN AC GENERATOR COOLING PROBLEM!

SPECIFICATIONS

208/120 Volts, 0.75 Power Factor, 3 Phase, 400 CPS

Type No.	Rating KVA	Rated Cooling Air Pressure in "H_2O"	Rated Cooling Air lb./min.	Diam. in.	Speed RPM	Approx. Weight lbs.	Flange and Drive Spline
*28E16-1	20	4	11	8.25	5700-6300	60	AND 10266 XVI-A
*28B23-1	20	4	11	8.25	4800-7200	65	AND 10262 XII-A
*28E17-1	30	8	14	8.25	5700-6300	69	AND 10266 XVI-A
*28E14-1	40	5	14.5	9.25	5700-6300	83	AND 10266 XVI-A
*28E15-1	60	6	16	9.25	5700-6300	103	AND 10266 XVI-A
28E19-1	10	4	7	6.5	7600-8400	30	AND 10262 XII-A
28E19-3	10	4	7	6.5	7600-8400	31	New 9" Flange
28E20-1	20	6	8.5	6.5	7600-8400	45	AND 10262 XII-A
28E20-3	20	6	8.5	6.5	7600-8400	46	New 9" Flange
28E21-1	30	10	12.4	6.5	7600-8400	60	AND 10262 XII-A
28E21-3	30	10	12.4	6.5	7600-8400	61	New 9" Flange
**28E10-1	9	6	8.6	6.5	7600-8400	39	AND 10262 XII-A

*These generators include integral fan permitting full load continuously up to 80°C at sea level with no additional cooling.

**This generator incorporates a DC output of 30 volts, 50 amps capacity in addition to the AC output.

All generators have been designed to MIL-G-6099 and MS-33542, which specifies cooling air of 120°C at sea level, 40°C at 50,000 ft., and −12°C at 65,000 ft., and will deliver full-rated load under these conditions.

ECLIPSE

Bendix Red Bank

HIGH-TEMPERATURE AC GENERATORS

meet military class C air-cooled specifications ... offer maximum performance at minimum size and weight... range from 9 KVA to 60 KVA

These generators are designed as part of complete Red Bank high-temperature AC generating systems that also include magnetic amplifier voltage regulators and system protection components. For full details, write Red Bank Division, Bendix Aviation Corporation, Eatontown, New Jersey.

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.
Export Sales and Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

Red Bank DIVISION

Bendix AVIATION CORPORATION

ENGINEERS WANTED: Opportunities now available for experienced design engineers to work on aircraft type AC and DC rotary power supplies and associated control equipment and distribution systems. Write today: Attention of Personnel Department K.

PERKIN-ELMER'S
Jack and Charlie
WHY SHOULD ANYONE WANT TO WORK FOR PERKIN-ELMER?
JACK!!!
EASY, CHARLIE, I'M TRYING TO WRITE A "HELP WANTED" AD THAT GETS ACROSS ALL THE THINGS P-E CAN OFFER GOOD ENGINEERS AND PHYSICISTS...
ADVERTISEMENT? WELL LET OL' GRAY FLANNEL CHARLIE HELP YOU WITH IT.
FIRST OF ALL, LET'S TELL 'EM WHAT PERKIN-ELMER DOES... DESIGNS AND PRODUCES FINE OPTICS, INFRARED INSTRUMENTS, ELECTRO-OPTICAL WEAPONS SYSTEM....
...TO SAY NOTHING OF SECRET INFRARED DETECTOR STUFF.
THEN WE TELL 'EM ABOUT THE PROJECTS THEY'LL BE WORKING ON...
EVERYTHING FROM AERIAL CAMERAS TO ZOOM LENSES, ETC. AND SO FORTH.
AND THE MEN THEY'LL BE WORKING WITH... CARL MILLER WHO HELPED DEVELOP RADAR.... LLOYD McCARTHY, A LEADER IN OPTICAL DESIGN.. ...AND MANY OTHERS WELL KNOWN IN OPTICAL TRACKING, INFRARED AND SO FORTH...
...NOT TO MENTION US, JACK AND CHARLIE IN PERSON.
CHARLIE
AND LOCATION! OUT IN THE BEAUTIFUL CONNECTICUT COUNTRYSIDE WHERE TRUE SUBURBAN LIVING IS A REALITY. ..NO MORE COMMUTING.
REMINDS ME! HAVE TO TELL MY WIFE I'LL BE HOME FOR LUNCH.
HAVE WE LEFT ANYTHING OUT?
NOTHING EXCEPT THE SPECIAL BRAND OF ENTHUSIASM YOU PICK UP WORKING AROUND HERE, BUT THEY'LL HAVE TO DISCOVER THAT FOR THEMSELVES
I'LL CLOSE IT..."IF YOU'RE A PHYSICIST, ENGINEER, OR DESIGNER, WE'D SURE LIKE TO KNOW MORE ABOUT YOU"
AND IF YOU'D LIKE TO KNOW MORE ABOUT US, LET US SEND YOU THIS BOOK.

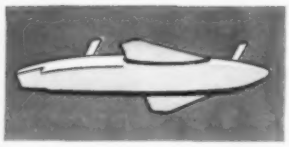
Perkin-Elmer is a diversified, growing young company, well known to both industry and defense people. Why not send our personnel manager a resume of your qualifications. And if you'd like, we'll send you a copy of "Perkin-Elmer . . . its people, facilities, products."

Engineering and Optical Division

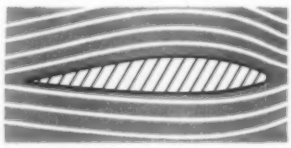
Perkin-Elmer *Corporation*

Norwalk, Connecticut

The remote corners of the world are now accessible to aircraft designed to include the Stroukoff Pantobase landing system. A product of Stroukoff research and development, Pantobase will permit landings and take-offs from snow, ice, water, sand and unimproved terrain as well as standard runways. The increased versatility of the aircraft will reduce the need for conventional airports and contribute materially to the advancement of logistical techniques. The safety of the Pantobase landing system, is assured by the extensive experience and complete reliability of the Stroukoff organization.



Pantobase – When designed into an aircraft the Stroukoff Pantobase system enables the plane to land and take off from many types of surface without changes or additional landing equipment.



BLC – Boundary layer control as developed by Stroukoff increases the effective lift and delays stalling of the wing, thereby reducing required speeds and distances for take-offs and landings.

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COVER: Swedish Saab J35 Dragon has gone into production. Light, small "double delta" interceptor is powered by a Rolls-Royce Avon engine and is capable of speeds well above Mach 1. Cover picture shows two of the three prototypes that are now flying. Further details on page 60.

Picture Credits:
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AVIATION WEEK • OCTOBER 29, 1956 • Vol. 65, No. 18
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The new 1649A Super Constellation spreads its wings! Major wing and propeller improvements planned for the new, longer-range Lockheed Super Constellation aircraft due in 1957 mean important changes in intercontinental flight. Carrying up to 9600 gallons of fuel, the new Super Constellation at ranges beyond 4200 miles will fly point-to-point 70 mph faster than other piston-powered airliners. By moving its four powerful turbo-compound engines farther outboard, along its 150-foot wingspan, Lockheed promotes additional quietness in passenger cabins.

Lockheed launches 3 new aircraft!

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The sea-going T2V-1, the first jet trainer designed to operate with U. S. aircraft carriers, flies at 600 mph, lands at 97 mph. Among its new features is a system by which compressed air from the engine is channeled into the wing and squirted through tiny holes directed at the flaps and ailerons, providing greater lift, improved anti-stall performance.

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EDITORIAL

What's Wrong With British Aviation?

For the past several years, there has been a rising tide of criticism on the state of British aviation—particularly its military products—from British aeronautical engineers, military airmen and the London daily press. Britons distinguished in aviation who have spoken publicly on this topic include Sir Roy Fedden, thrice president of the Royal Aeronautical Society and a distinguished aeronautical engineer; Air Commodore F. R. Banks, an internationally recognized authority on jet engine development; William A. Waterton, one of Britain's most experienced jet test pilots, and Sir Philip Joubert de la Ferte, a former air chief marshal of the Royal Air Force.

Our British contemporaries of the technical press, *Flight* and *Aeroplane*, also have noted that all is not well on this score and have urged action to improve matters.

The main point of all this criticism is that the Royal Air Force is now, and is likely to be for the foreseeable future, saddled with obsolete aircraft. Air Commodore Banks ranks the current RAF fourth among world powers in quality of equipment, trailing the U. S., Russia and Sweden. There are indications that the present rate of progress of the French aircraft industry may push the RAF equipment down to fifth place soon.

Many Britons, fed a steady diet of press releases from the Society of British Aircraft Constructors' non-technical staff and headlines "Britain Leads in the Air" from the penny press, are not fully aware that the Royal Air Force could put no fighters into MiG Alley in Korea capable of holding their own with the Russian MiG-15. Nor are they fully aware that for the last three years the first-line fighter of the Royal Air Force has been the American designed, Canadian-built F-86 Sabre. Now that the Hawker Hunter has finally come into limited squadron service—"years late," according to Air Vice Marshal Thomas Pike—it is thoroughly outclassed by the F-100 Super Sabre and MiG-19 day fighters and the F-102A all-weather fighter.

These planes are supersonic in level flight, while the Hunter still needs a shallow dive to nudge Mach 1. With the cutback in Javelin production and cancellation of advanced supersonic all-weather fighter projects, the RAF outlook in this vital field is even worse than it is for day fighter equipment.

The guided missile situation is even worse, with Britain already lagging at least two development generations behind this country. Bomber development is in better shape, but even Britons are puzzled as to how their limited airpower budget can support three V-bomber programs without seriously crippling other critical development areas. Only in the gas turbine engine field is the British military aviation picture really bright. Britain now has a variety of gas turbine engines covering the power spectrum from 1,000 lb. thrust to 19,000 lb., a record hard to find in any other country. But this brilliant engine development will avail little without the airframes to utilize them properly and gather the precious operational experience on which future engine development must be nourished.

We do not recite these sad facts to twit our British friends. The current state of British military aviation development is a matter of deep concern to our military planners in the Pentagon and to the American people. It is not a pleasant sight to watch an ally whose military airpower record is so distinguished slide down the technical scale towards obsolescence. Maintenance of a strong Royal Air Force is just as vital to the American people with their huge stake in the NATO alliance and world peace as it is to Britons.

What appears to be the trouble with the current state of British military aviation? British critics appear to agree on four principal points:

• **Lack of the proper investments in the research and development tools required for exploration of the speeds and altitudes of the supersonic range of aircraft and the hypersonic range of missiles.** This includes wind tunnels, altitude chambers, test sleds, and, perhaps most important of all, a high-speed flight research program similar to the X series aircraft sponsored jointly by the U. S. Air Force, Navy and National Advisory Committee for Aeronautics.

• **Bureaucratic bungling by the Ministry of Supply.** This system imposes another government agency between the aircraft industry and its prime customers—the Royal Air Force and the commercial airlines. MOS control of aircraft development and procurement has led to a widening gap between RAF requirements and the equipment actually developed and built by the industry.

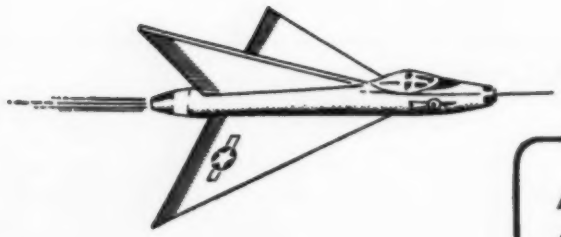
• **Lack of the weapon systems concept in developing new aerial weapons.** Establishing this concept in USAF and Navy aerial weapons development was no easy task against all of the forces of entrenched tradition. But, without its firm recognition, we too would still be developing aircraft rather than weapon systems. Almost every current British military aircraft is bulging with devices added after the main design process was completed but found necessary to turn a flying machine into a fighting machine.

• **Lack of genuine economic competition in the aircraft industry.** Too much of the limited airpower budget is wasted on "consolation prize" prototype orders and small production orders to losers of the technical competitions in order to keep their firms alive.

No amount of official White Paper whitewash or SBAC press releases can gloss over the validity of this criticism from Britons each of whom has had far more practical experience with military aviation than the combined total of the official apologists.

No foreign advice will help to solve Britain's military aviation problems, nor do we propose to offer any. The British will have to make their own searching analysis of their present predicament and work out a solution within the framework of their technical and financial resources. But we earnestly beseech those most vitally concerned with British military aviation progress to "get cracking" and to get on with this vital job before it is too late. The whole future of the Western alliance and the free world depends upon having a strong, independent Royal Air Force flying close formation with the British Commonwealth air forces, the French Armee de l'Air and the U. S. Air Force and Naval Aviation.

—Robert Hotz



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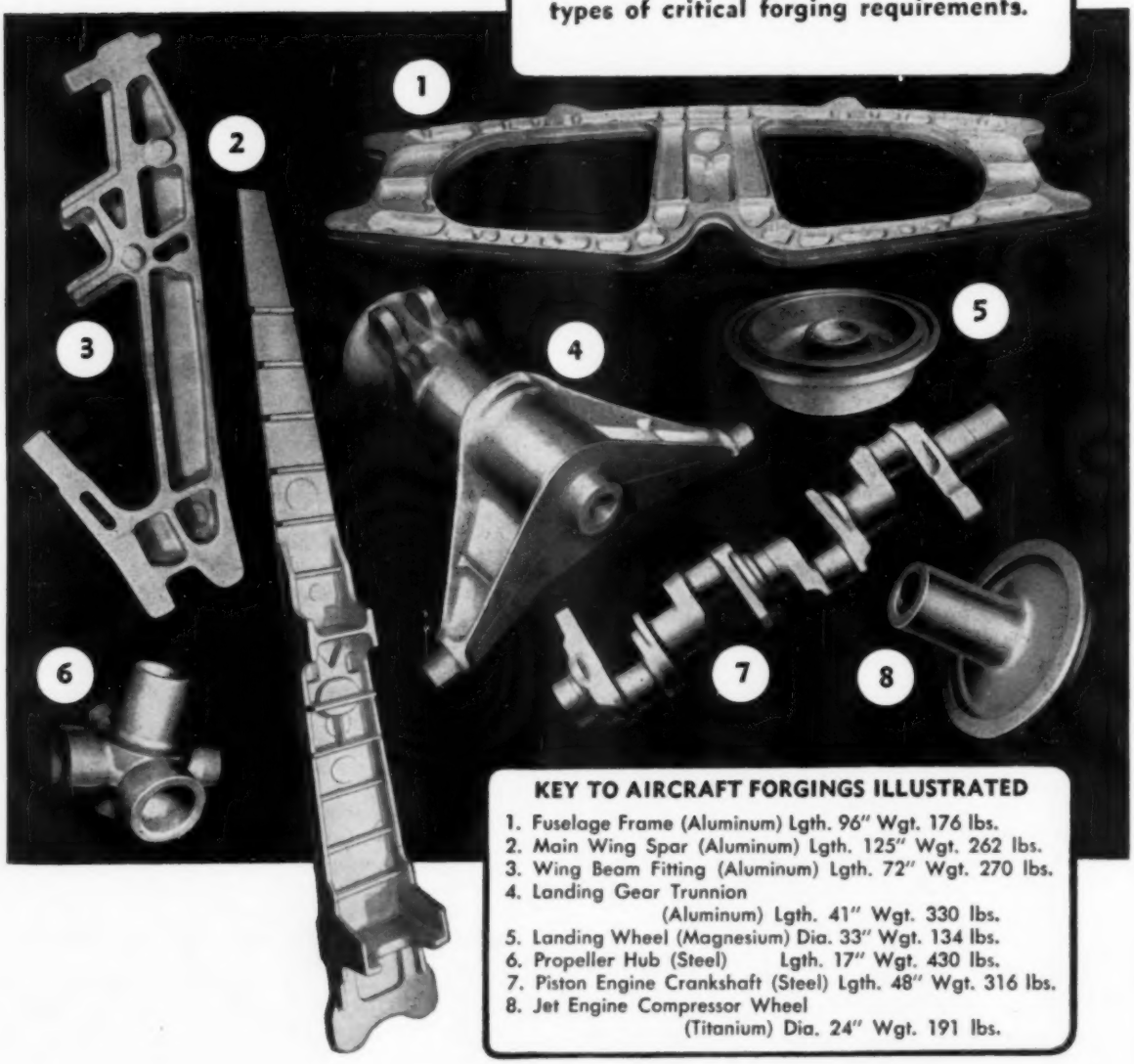

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1. Fuselage Frame (Aluminum) Lgth. 96" Wgt. 176 lbs.
2. Main Wing Spar (Aluminum) Lgth. 125" Wgt. 262 lbs.
3. Wing Beam Fitting (Aluminum) Lgth. 72" Wgt. 270 lbs.
4. Landing Gear Trunnion (Aluminum) Lgth. 41" Wgt. 330 lbs.
5. Landing Wheel (Magnesium) Dia. 33" Wgt. 134 lbs.
6. Propeller Hub (Steel) Lgth. 17" Wgt. 430 lbs.
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WHO'S WHERE

In the Front Office

Charles H. Colvin, president of Colvin Laboratories, Inc. (East Orange, N. J.), a director, Avien, Inc., Woodside, N. Y.

Roland T. Outen, company chairman, Fairey Aviation Company Ltd., Hayes, Middlesex, England.

Lawrence G. Haggerty, president, Farnsworth Electronics Co., Fort Wayne, Ind. Mr. Haggerty succeeds **Dr. Harvard L. Hull** now a vice president of Litton Industries, Beverly Hills, Calif.

Byron F. Sherrill, assistant to the board chairman, Trans World Airlines, Inc.

Robert G. Patterson, assistant to the president, and **James G. Rayburn**, vice president-general sales manager, Lamson & Sessions Co., Cleveland, Ohio.

E. M. Schugar, vice president-government contracts, Houdaille Industries, Inc., Buffalo, N. Y.

Stanley J. Roush, group vice president, Borg-Warner Corp., Chicago, Ill.

George G. Gauck, vice president-sales, Zero Manufacturing Co., Burbank, Calif.

John E. Stephen, general counsel, Air Transport Association, Washington, D. C.

Honors and Elections

Constantine L. Zakhartchenko, Washington, D. C. consulting engineer and former Navy engineer, has received the Navy's Distinguished Civilian Service Award for his part in developing the Navy's new guided missile, Petrel.

Robert H. Curtis, Continental Air Lines meteorologist, has been elected chairman of the Air Transport Association Meteorology Committee.

Raymond S. Perry, president of Federal Telephone and Radio Company, has received the Air Power Trophy, the top award of the Air Force Association's New Jersey Wing, for his contribution to a wide variety of military and commercial aircraft products, including Tacan. **Henri Busignies**, president, and **Brig. Gen. Peter C. Sandretto**, vice president-technical director, of Federal Telecommunication Laboratories, received the Wing's Research and Development Award for 1956.

Dr. John L. Miller, director of defense activities for Firestone Tire & Rubber Company, has been appointed deputy chairman of the Artillery Division of the American Ordnance Association, and also elected a member of the A.O.A. National Council.

Changes

Robert M. DeHaven, associate director, aircraft operations and flight test, Hughes Aircraft Co., Culver City, Calif. Also, **Thomas B. Carvey**, launchers and power plants department head, Hughes' guided missile laboratories.

Roland C. Bergh, acoustics specialist (director of jet-noise suppression program), Republic Aviation Corp., Farmingdale, N. Y.

Dr. George Roka, director, semi-conductor division, Marvelco Electronics Division, National Aircraft Co., Burbank, Calif.

INDUSTRY OBSERVER

► General Electric liquid-propellant rocket engine for the Vanguard satellite has been delivered on schedule after qualifying at a design thrust of 27,000 lbs. GE's program for the engine is on schedule, and the company foresees no problem in meeting its phase of the Vanguard tests and firing dates.

► **Work is almost complete on five pre-production models of Dassault's Super Mystere B2 multi-purpose fighter. Production models are due to begin rolling off the production line of Dassault's Merignac plant in early 1957. French air force already has ordered 305 of the aircraft, making it the first European fighter capable of supersonic speeds in level flight to be ordered in quantity. Powered by a Snecma Atar IX turbojet with afterburner, the B2 carries two 30 mm. cannon and missiles.**

► First Lockheed F-104A Starfighters are scheduled to go into operational service early next year at one of USAF's West Coast bases.

► **Main cargo hold of 500 mph. Douglas C-132 turboprop transport is large enough to accommodate five cross-country buses. Smaller cargo hold in upper part of the "double-bubble" fuselage is believed to be almost large enough to hold a DC-6 fuselage. Spacious extra crew quarters are located forward of the upper hold. Access to cockpit is by stairway from main hold. Sixteen-wheeled main landing gear is made up of four co-axial quads. Each quad has four wheels on single axle which rotates 90 degrees to retract into fuselage pods similar to those on C-133.**

► Electronic firing system for Canada's CF-105 delta-wing supersonic fighter probably will be produced by RCA-Victor Ltd. in Montreal. Development work will be carried out at RCA's David Sarnoff Research Center in Princeton, N. J.

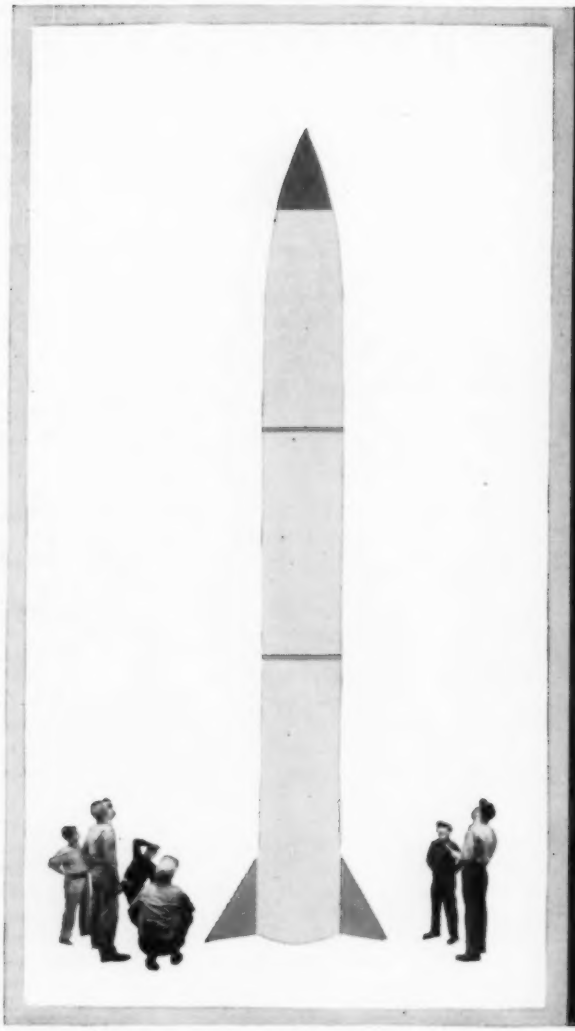
► **A 108-ft. high, above-ground tank for testing moored mines and air-dropped antisubmarine weapons is scheduled to go into service this week at the Naval Ordnance Laboratory, Silver Spring, Md. The tank, 50 ft. in diameter, allows better control and observation of test results, easier recovery of test items than testings in harbors and ocean. Hydrodynamics, mechanical function, and function of certain pyrotechnics and propellants can be tested. Portholes allow for photographs. A wood-and-steel platform forms a "false bottom" for tank, can be raised or lowered to vary depth of test.**

► Breguet 1100 Taon, lightweight tactical support fighter, has been redesigned to follow the area-rule concept. The aircraft, to be powered by a Bristol Orpheus engine, is scheduled to make its first flight sometime this winter.

► **Sikorsky has tripled the skin thickness on commercial version of its S-58 helicopter, adding 350 lb. to the empty weight of the aircraft. Rear compartment of the helicopter, originally designed for electronic gear, has been converted into passenger space, and the electronic gear is now stowed beneath the pilot's compartment.**

► Closed-circuit telecasting of hurricane radar maps to East and Gulf Coast stations is being considered by the Weather Bureau. System would permit local meteorologists to view first-hand the progress and development of a storm. Television signal can be transmitted over a 3,000-cycle telephone wire to a slow scan receiver with storage tube. Bureau also might extend coverage to the Midwest tornado area.

► **Hispano-Aviacion S. A. is designing a four-seater liaison plane derived from its HA-200 R-1 trainer. Powered by two small turbojet engines, the aircraft has the company designation of HA-231 R-1. Military designation is XL-11.**



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Washington Roundup

Army Steals Missile March

Army has stolen a march on its sister services in the ballistic missile race by demonstrating the technical advances made in multi-stage, long-range rocket firings. The Army Ballistic Missile Agency, as part of a planned program leading to the Jupiter intermediate-range ballistic missile, has fired a three-stage rocket for a distance of 3,000 mi. from the Air Force Missile Test Center at Patrick AFB, Fla.

The first stage, a 75,000-lb. thrust Redstone power unit, plunged into the sea 200 miles from the launching site. The second stage, a cluster of four Baby Sergeant solid-propellant rockets, hit 800 miles from the firing point. Third stage was a single Baby Sergeant which hit about 3,000 mi. downrange "within the target area" according to informed sources. For an optimum ballistic trajectory of this range, the peak altitude could be expected to approach 600 miles. Primary purpose of the firing was to check stage-separation techniques.

Second Thoughts

Adm. Arthur W. Radford, chairman of the Joint Chiefs of Staff who four months ago termed warnings of the Soviet Union's military capabilities "almost hysterical" in some respects, said last week that recent Russian air-atomic advances were "something of a shock." Speaking at a Harmon International Aviation Award luncheon here, Adm. Radford warned:

"The rapidity with which the Soviets developed their long-range jet bombers and their atomic weapons has been something of a shock to the free nations."

"Such rapid developments in jet bombers and atomic weapons," he added, "demonstrate that their primary technological emphasis is devoted to the military applications of airpower as an instrument of war."

Testifying before the Senate Subcommittee on the Air Force in June, the admiral said: "I think we are in a dangerous position *vis-a-vis* the Communists . . . today, because there has been an almost hysterical assumption of great capabilities on the part of the Communists, some of which, in my opinion, actually do not exist."

Censors Raise Military Hackles

Mounting Pentagon resentment against petty censorship by youthful aides of Assistant Defense Secretary Robert Tripp Ross is reported to have come to the attention of the top boss, Secretary Charles E. Wilson. Both military and civilian officials, all of them high-ranking, have been forced to submit to changes in their speeches put there by Ross' assistants, Donald B. McCammond and Philip K. Allen.

Most recently, Army Chief of Staff Gen. Maxwell D. Taylor, commander of 1,013,508 men, had a speech returned from McCammond's desk with about 100 petty alterations. Previously, Army Secretary Wilbur Brucker had a speech practically killed by black pencils in the office of the Assistant Secretary for Legislative and Public Affairs. Mr. Brucker, an experienced attorney and former governor of Michigan, voiced indignation.

The Air Force also has had its troubles. Gen. Nathan Twining, chief of staff, and USAF Secretary Donald Quarles conduct a running competition with Ross' office, trying to tell the Air Force story despite security, policy and grammatical wrinkles introduced by the latter. USAF speech writers now have resorted to introducing new facts in an effort to see what can get by.

McCammond, executive assistant to Ross, has a background of seven years in public relations work for chemical manufacturers in New England. Allen, strong Republican party worker and former member of the legislature in Massachusetts, has been employed at Harvard.

Stock Hearings

The Senate Permanent Investigating Subcommittee will hold "extensive public hearings in the near future" on the heavy trading of Northeast Airlines stock on Aug. 3—the morning after the Civil Aeronautics Board awarded a Miami-New York route to the carrier in executive session. It was another week before the decision was made public.

After several weeks study, the subcommittee staff has developed sufficient evidence of irregularities to warrant the hearings. The main problem is to get senators on the subcommittee together in Washington. Sen. John Williams (R.-Del.) called for the investigation "to see that the question as to who leaked advance information does not remain unanswered."

Robert Griffith, assistant to the president of Delta Air Lines, is scheduled to be a key witness at the hearings. Several of the 21 CAB members and CAB staff members present at the session on the Northeast decision will be called. Delta had been recommended by a CAB examiner to receive the route.

The subcommittee is headed by Sen. John McClellan.

Curtis Favors New Airport Group

A national organization with the authority to implement an airport plan that will meet the approval of both Congress and users has been urged by Edward Curtis, special assistant to the President for aviation facilities planning. In a recent address before the National Business Aircraft Assn., Curtis said there is a need for an overall plan for an airport system that will give airport operators some guidance in providing proper runway lengths, high speed turn-off requirements and facilities. He called for a cost estimate in airport planning to permit an equitable distribution of costs between federal, state and municipal agencies and the airport users.

Another CAB Investigation

The Civil Aeronautics Board last week added to its growing list of airline investigations when it voted to launch a review of Air Traffic Conference and International Air Transport Assn. travel agent agreements. Airline travel agent agreements came under fire at hearings held last Spring by the House Antitrust Subcommittee. Since then, the Board has continued to receive criticism from travel agents and congressmen, and now an investigation of the system has been instituted.

Air Transport Assn. President Stuart G. Tipton predicts the investigation will show the agreements do a good job of protecting the public. He points out that the carriers have to exercise a certain degree of care to make sure that agents representing the airlines are trustworthy, and that the CAB has always approved the agreements when they have been reviewed in the past.

—Washington staff

USAF Pushes Maintenance Demands

Maintainability requirement may be written into all contracts; jet engine makers to feel change first.

By Claude Witze

Washington—U. S. jet engine manufacturers next year may be called upon to accept the first Air Force contracts to include maintenance specifications.

The specifications will call for inclusion in the design of features that will ease the burden on USAF personnel in the field. In addition to describing the maintainability requirements, they will spell out the procedure by which the Air Force will determine that the requirement has been met.

The vital importance of the jet engine maintenance situation was pointed up last week at an overhaul symposium held at Tinker AFB, Oklahoma City. (See page 32.) Airline representatives, soon to face jet overhaul problems of their own, were given a staggering array of figures on costs and the man hours of labor required to keep jet and turboprop powerplants in top condition.

Information available to AVIATION WEEK indicates that USAF's plan to write maintenance specifications into jet engine contracts still is in the embryonic stage. One spokesman said the idea is being "toyed with." On the other hand, it is clear from what was disclosed at Oklahoma City and from the facts about skill shortages in the Air Force that stern action is imminent and necessary.

Industry Aware of Problem

Compulsory design of improved maintenance in new jets will be the first step towards an eventual overall policy to include such specifications in all weapon system and component contracts.

At the same time, USAF already is giving credit to the aircraft industry for grasping the importance of its current maintenance problem and acting to relieve it. Complex aircraft now on the drawing boards of major U. S. aircraft plants have vastly improved maintenance features, minimizing the requirements for skilled manpower, extensive training, special tools, test gear and facilities.

Security blankets identification of these projects and details on what has been incorporated to help USAF maintain combat readiness in an era of fast-growing complexity and skill shortages. But both the Air Force and Defense Department see the changes as a result of a two-year effort to make manufacturers more aware of the problem.

A growing number of aircraft firms, particularly the larger ones, now have maintenance experts "kibitzing" over the shoulders of weapon system designers. Lockheed, for example, has a special group of ten men—five engineers and five "tech rep types"—who keep a close watch on all new projects to protect the USAF mechanic from unnecessary complications in basic design.

Where Problem Lies

Convair, Douglas, North American and others have taken similar action. Usually, the groups are called "Maintenance Design" or "Maintenance Engineering" units, attached to the regular engineering and preliminary design staffs.

Some of their early efforts already are paying off in maintenance improvements on such aircraft as the Convair F-102, the Lockheed F-104 and Douglas C-133.

In a letter to the Aircraft Industries Assn. last April, Lt. Gen. Clarence S. Irvine, deputy chief of staff for materiel, declared that a large portion of the increase in maintenance "is due to built-in problems." He announced that the Air Force will give maintainability "more weight" in the selection of future equipment.

Industry reaction to this announcement was mixed. Some major companies already had taken steps along the lines urged by Gen. Irvine. Others, much as they approved of the idea, retained skepticism as to USAF's sincerity.

Most common complaint is that, when it comes to picking the winner in a design competition, performance and weight have been the ruling criteria.

The contracting officer, according to these observers, is looking for maximum performance, minimum weight and cost.

Performance Cost

When easy maintenance is built into a weapon system it can result in added weight and cost, slightly poorer performance. The cost should be a minor factor because easy maintenance can cut operating expenses enough to more than offset the added initial outlay for the equipment.

Some contractors contend that they have lost competitions because of sacrifices made in the interest of easy maintenance.

Gen. Irvine's letter indicates that USAF is determined to correct this condition. The step undoubtedly can be traced in large part to recent and current experiences with such aircraft as the North American F-100.

In the case of the F-100, only a year ago the first activated unit (the 450th Fighter Day Wing) was seriously handicapped because it did not have sufficient skilled personnel to keep the complex Century-series fighter operational (AW Dec. 19, p. 14).

The record on the F-100 has since improved, but only because of USAF's strong on-the-job training program and assistance provided by the manufacturer under contract.

North American personnel are based with the planes, both in the U. S. and abroad.

Accessibility is the major problem to the USAF mechanic. Other factors are simplicity of the system itself, the checking system and the tooling required. Changes in any of these, away from proven practices, naturally can effect reliability. And reliability, in the long run, is just as important as maintainability.

Figures obtained from a reliable source indicate that the average F-100 still requires better than 50 man hours of maintenance work for every flying hour.

On the F-100D, for example, it is necessary to remove the engine in order to do overhaul work on the constant speed drive. This means that this one job can consume as much as 37 man hours, a figure that could be cut by an estimated 70% if the design were different.

Jet-Engine Problems

Other common complaints against USAF equipment include such obvious things as inaccessibility of the oil supply dip stick and inverters. On some aircraft, according to one expert, it is always too difficult to work on vital parts of the electrical, hydraulic, heating and power adjustment systems.

Just as the contract program is expected to start with future engine designs, all component manufacturers will face more pressure from the USAF and the Defense Department for action to ease the maintenance crisis.

Jet engines are a clear starting point for this effort because too little attention has been given to field replacement on key items in the compressor, combustion and turbine areas. Design with these things in mind, it has been estimated, could cut down on major overhauls to a substantial degree.

The Air Force program to improve the maintenance situation actually goes back to the spring of 1954, when Gen. E. V. Rawlings, chief of the Air Materiel Command, told the Aircraft Industries Assn. he was concerned about the widening gap between USAF

skill levels and the complex aircraft he was buying.

A staff study was conducted and out of it grew Air Force Regulation 66-29, first issued in September 1954, and revised in June of this year.

Maintenance in Design

AFR 66-29 calls for maintenance features to be built into a design and orders AMC and the Air Research and Development Command to monitor projects for this purpose. It provides for maintenance engineering participation in mock-up and contractor technical compliance inspection boards. At the outset, the program was hampered by the fact that the Air Force had few personnel competent to spot maintenance bugs on the design board.

About a year ago, the Defense Department's Office of Applications Engineering was given overall cognizance of a similar project to cover all branches of the armed forces and all equipment. This office now has a committee working out a Defense Department policy to effect uniformity in the approach. It is expected that in about two years maintainability provisions will be made standard in all defense equipment contracts.

Low Cost Helicopter To Challenge Industry

Washington—U. S. Army will throw a major challenge at the helicopter industry next year with a design competition for an observation helicopter with a price tag in the $10,000 range.

Maj. Gen. Hamilton H. Howze, Army Aviation director, says the new aircraft must be simple and small. His requirement that it cost a third of the price of present observation helicopters indicates that only a radically-new design will fill the specifications.

In an address at the annual meeting of the Assn. of the U. S. Army here last week, Gen. Howze listed these other requirements:

• **High-performance,** fixed-wing aircraft with a speed of 275 to 300 knots, able to land and take off over a 50-ft. obstacle within 600 ft. Now in design competition, it should be available by 1960.

• **Fixed-wing cargo plane** capable of carrying a 2½-ton payload. Cruising speed, 200 knots, for takeoff and landing within 500 ft. A similar four-ton transport should have a speed of about 250 knots.

• **New utility helicopter.** This is the Bell XH-40 that will fly within the next two months. Powered by turbo-shaft engines, it will cruise at 100 knots and carry a 1,000 lb. payload.

• **Medium cargo helicopter** for a payload of three tons, also powered by turbo-shaft engines. Proposals are being considered. One of them is the Vertol turbine-powered H-21.

• **Flying crane** for heavy loads of eight to 15 tons. Now being studied by the industry, a design competition is expected next year.

• **"Aerial jeep,"** to weigh 1,000 lb. and carry an equal payload. There will be a design competition this year, and the vehicle should be ready for troop test by 1959.

Hound and Horse

World-record holding helicopters of the Russian air force demonstrate loading and carrying capability. Mi-4 Hound (above) has clamshell doors under the tail boom, can carry light weapons or vehicles. Hound holds two payload-to-altitude records and one speed record homologated by FAI. Yak-24 Horse (below) weighs 35,000 lb., has an 8,800-lb. payload; it holds two official world records for carrying fixed payload to altitude.

British Air Official Replies to Criticism

Possession of bomber types as the British V-class is the key to airpower, Nigel Birch, British Secretary of State for Air said in reply to criticism that in quality of equipment the Royal Air Force ranks behind America, Russia and Sweden (see page 21).

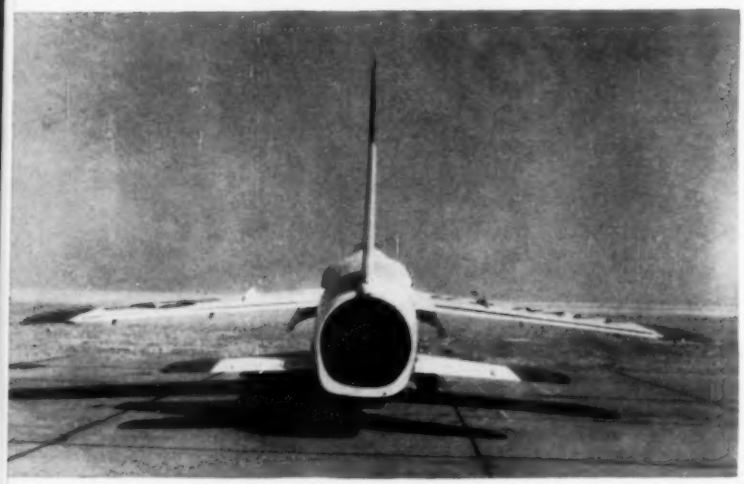
"Except in extremely long-range, which we do not need," Birch said, "I believe that our V bombers have a better performance in speed, height over target, and maneuverability than their United States and Russian equivalents.

"The Swedes have no medium or heavy bombers. Moreover, the Swedes are busy buying our Hunter fighters, which hardly looks as if they share the black views of some people here at home."

Air Commodore F. R. Banks, a director of the Bristol Aeroplane Co., in ranking the RAF equipment fourth, had suggested the British look to American industrial techniques for adaptation in Britain. (AW Oct. 22, p. 32).

Birch said that British procurement methods had been improved since 1952, and that he intended to try to improve them further.

LATEST Tiger in flight shows wing root and tail extensions characteristic of this modification of the supersonic fighter.



J79 Demands Larger Fuselage for F11F

LATEST variation on the Grumman Tiger theme is the F11F-1F, powered by a General Electric J79 turbojet with afterburner. Thrust rating of the engine without afterburning is about 12,000 lb. Two prototype 1Fs have been built and are being flown at Edwards AFB, Calif. Production Tiger with Wright J65 is supersonic in level flight; 1F is substantially faster.

REAR VIEW shows enlarged fuselage required for J79 installation (above). Installation uses air nozzle rather than mechanical means for controlling the engine jet exhaust area during various power conditions. Air nozzle has advantage of simplicity and lack of mechanical links in the hot blast of the exhaust. Other changes on modified Tiger include a rebuilt aft fuselage to take the larger diameter of the afterburner, increased capacity for the intake ducts, wing leading edge extensions at the root and a single-pane clear windshield replacing the original three-pane design.

BELLY plan of F11F-1F shows external changes: extended wing leading edge, swelled rear fuselage and new engine inlet ducts.

ARDC to Test Crew Endurance For Extended Nuclear Flights

Wright-Patterson AFB, Ohio—A five-man crew will "fly" a five-day mission in a grounded aircraft cabin early next February under the kind of conditions that might be found in the Air Force's WS-125A nuclear-powered bomber.

The purpose will be to test individual efficiency and endurance as well as the ability of the Air Research and Development Command volunteers to live and work together in confined quarters over a long period of time.

The cabin is being built in a nose mockup, resembling a B-36, which Convair Division of General Dynamics Corp. used for another project and then turned over to the Air Force. Convair has one of the two Air Force airframe contracts for the nuclear bomber, but is not involved in the endurance project.

Lockheed Aircraft Corp., which has the other airframe contract for the WS-125A, will install a cockpit at its Marietta, Ga., plant for similar but more extensive tests. These are expected to begin next summer.

The 120-hr. test is an extension of 24- and 56-hr. endurance tests. It is a project of the Stress and Fatigue Section of Wright Air Development Center's Aero Medical Laboratory. Project director Charles A. Dempsey has been a volunteer subject in the earlier tests.

Crew members will wear no helmets or parachutes. They will be photographed, watched by two closed-circuit television cameras and wired for brain, heart and skin responses. All conversations between crewmen and test operators will be recorded.

Emergencies will be simulated by changes in instrument readings, placing a smoke bomb in the air conditioning system or merely by announcing one.

Each man's station also is his emergency escape capsule. In emergencies, panel instruments will operate in each station.

The aircrew will be divided into two groups. Pilot, co-pilot and engineer will be interchangeable, so that one can rest while two work. The navigator and defense director also will be interchangeable, with one on duty as navigator at all times.

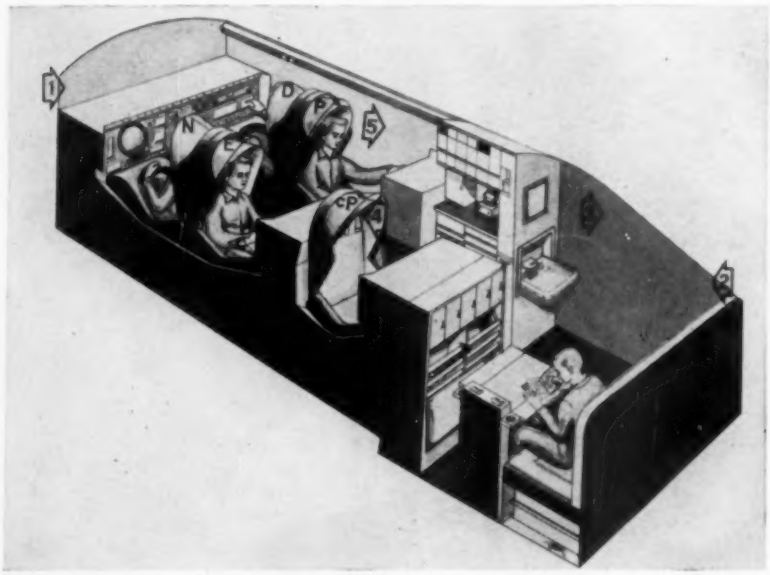
Measurements will be made of the time it requires crew members to determine from flashing panel lights that some action must be taken, and the time it takes them to complete the action.

Here are some of the cockpit's features:

- **Bulkheads and capsules** will be padded, making helmets and parachutes unnecessary.
- **Each man will have** a choice of three programs of recorded music, piped through the communications system.
- **All furnishings** will be kept at shoulder level or below to give a feeling of spaciousness. The effect of spaciousness also will be increased with dark floors and lighter walls and ceiling.
- **Indirect lighting** can be varied from cool to warm colors. Lights also can be dimmed to create the illusion of night flight.
- **Cabin, although small** will contain a "rest and recreation area" that includes a food bar and sanitary facilities.

Lt. John H. Duddy and Jack Hockenberry are project designers; Capt. Albert J. Silverman is in charge of medical research; Lt. W. Dean Childs will monitor psychological aspects, and Capt. Sanford I. Cohn will be in charge of bio-electrical and bio-chemical phases.

The cockpit is being constructed by WADC's Experimental Fabrication Division shops.



ARTIST'S conception shows five-man crew in nuclear-powered bomber cabin. Letters are P for pilot, E for engineer, CP co-pilot, N navigator, D defense director. Figure 2 shows leisure area, 3 indicates lighting, 4 communications hearing area, 5 bulkhead padding. Left of figure 3 is food bar.

Honolulu Residents Battle Jet Noise

Honolulu—Residents of Honolulu are reacting violently to noise engendered by the jet air age, probably the first city in the world to do so on such a large scale.

The outcry has been caused by several large movements of Boeing B-47 jets taking off from Hickam Air Force Base over the city, and a recent decision to cut a projected 12,000-ft. USAF runway from the Fiscal 1958 defense budget. The runway, especially for jets, would point seaward.

The community clamors to have the funds restored every time another B-47 screams over the city on takeoff from the base. The USAF installation and Honolulu International Airport are side-by-side and share a 15,000-ft. runway, but due to trade winds the heavy bombers often must fly out over the city.

Airlines have worked out a traffic pattern involving a sharp right turn to seaward a short time after crossing the field boundary, but jets needs more airspeed before turning.

Despite the lopping of funds for the USAF runway, the Hawaii Aeronautics Commission's plans for a $5 million improved "jet airport" include the USAF portion.

Ben E. Nutter, Superintendent of Territorial Public Works, said that if the USAF runway financing is reinstated at an early date, the runway could be completed about the same time as the proposed new terminal—July 1959.

Plans call for an administration building seven stories high with a two-story control tower. Parking space and landscaped islands will be constructed behind the main building. The terminal will be divided into four areas to take care of passengers arriving from the Mainland, those departing overseas, foreign arrivals and inter-island arrivals and departures.

C-130 Equipped With New Radome

Lockheed C-130 Hercules, taxiing to ramp at Allison Flight Research hangar at Weir Cook Municipal Airport, Indianapolis, Ind., carries new radome that adds 2.5 ft. to previous fuselage length of 95.2 ft. Called the "Pinocchio nose" the radome houses new APN/59 radar system which replaces APS/42. Sperry's APN/59, which employs two 5 deg. beams—a narrow pencil beam for pinpointing a target and a cosecant square beam for observing an area—increases range and resolution of radar, enables terrain, weather and aircraft detection. An 81-in. paraboloid which transmits the two beams is expected to be replaced by a 30-in. paraboloid to improve performance further. Radome is equipped with deicing ducts. Extensive flight test program is planned by Allison, which has just received a $17 million contract for T56 turboprop engines for the C-130, part of the $100 million, fifth production contract received by Lockheed for the aircraft.

Cessna's 1956 Sales Exceed $66 Million

Wichita, Kan.—Sales of Cessna Aircraft Co. for its 1956 fiscal year were reported in excess of $66 million.

Cessna President Dwane L. Wallace told a board of director's meeting the figure is a 32% increase over sales of $50 million during the 1955 fiscal year. He said the increase primarily was due to commercial aircraft sales.

A regular quarterly dividend of 35 cents a share will be paid Nov. 12 to stockholders of record Nov. 1. Final figures for the fiscal year were not available but earnings were expected to exceed $5.50 a share as compared with earnings of $3.88 for Fiscal 1955.

Services to Build 10 Minitrack Installations

Washington—The armed services will build 10 Minitrack ground stations for radio tracking of the Vanguard satellite.

The Army will build and operate seven of the stations. The Navy will operate two. One will be the joint responsibility of the Navy and Air Force. Seven will be situated approximately on the 75th Meridian, one on the 60th Meridian and one near the 115th Meridian. Altitudes will vary from near sea level to 12,000 ft.

In addition to these, a few Minitrack Mark II stations are tentatively planned. Mark II is a simplified Minitrack system.

The Navy will supply components for the Minitrack system and will train the crews. Information received by Minitrack stations from the satellite will be transmitted immediately to the Army Communication Center here and then relayed to the Vanguard Communication Control Center at the Naval Research Laboratory. Data will be reduced in the Vanguard digital computer facility here. Sites are:

- **Army** – Ft. Stewart, Ga.; Batista Field, Havana, Cuba; Mt. Cotopaxi, Quito, Ecuador; Ancon, Lima, Peru; Antofagasta, Chile; Peldehue Military Reservation, Santiago, Chile; and one site which has not yet been selected.
- **Navy**—Blossom Point, Md., (about 40 mi. south of Washington) and the Navy Electronics Laboratory, San Diego, Calif.
- **Navy-USAF**—Coolidge Field, Antigua Island, British West Indies.

Martin Co. Reports Third Quarter Sales Higher

Baltimore—Martin Co. reported sales of $89,805,834 for the third quarter of 1956, compared with sales of $87,827,737 for the second quarter.

Net income of $2,868,790 equaled $1.07 a share for the quarter, compared with $1.05 a share and net income of $2,855,507 for the second quarter.

A quarterly dividend of 40 cents a share was paid Sept. 26, 1956 to stockholders of record Sept. 7.

Small Firms Got Less USAF Funds in FY '56

Washington—The slice of Air Force business to small firms has dropped substantially, from 9% of the total dollar volume in Fiscal 1955 to 5% in Fiscal 1956.

Although the total of USAF prime contracts increased from $6.2 billion in Fiscal 1955 to $9.8 billion in Fiscal 1956, the dollar volume awarded to small businesses dropped from $576 million to $495 million, according to the Defense Department.

Over one third of the Fiscal 1956 USAF contracts with small firms ($170 million) were by advertised bid. But only a minor percentage ($52 million) of the contracts with large concerns were advertised.

USAF's allocation of prime contracts to small firms is far below the average for the Defense Department as a whole.

Of total defense business, 19% went to small concerns in Fiscal 1956 as compared with 21% in Fiscal 1955.

The Defense Department reported these apportionments of total dollar procurements to small firms in Fiscal 1956 (with Fiscal 1955 figures in parentheses):

Airframes, .2% (.4%); aircraft engines, .8% (.7%); guided missiles system, 2.1% (2.9%); miscellaneous aircraft equipment and supplies, 6.7% (7.9%); electronics and communication equipment, 10.% (11.8%).

Airlines Advised to Contract Jet Overhaul

By Irving Stone

Tinker AFB, Okla.—U. S. airline maintenance experts were introduced to the complexities of the jet engine here last week and advised to let contractors do their overhaul work, particularly in the early phases of the jet transport age.

Deluged with a flood of agonizing statistics drawn from USAF's experience, the airline representatives were given a sound briefing on what they can expect in fast-rising costs and manpower problems when their shops face jet engine overhaul. The preview was given at a symposium sponsored by the Oklahoma City Air Materiel Area for the Air Transport Assn.

Overhaul Headaches

Examples of major jet overhaul headaches discussed by the USAF experts:

• **General Electric J79** will require an average of 2,400 manhours for complete overhaul, although this time may be cut before the engine enters commercial service. Overhaul cost is about $71,000. The J79 will be used in Convair's 880 jet transport.

• **Pratt & Whitney J57.** Overhaul time is 1,052 manhours, not including 173 hr. for inspection. Material cost averages $15,000. A facility to overhaul 50 engines a month would cost about $4,270,000. The J57 will be used on some models of the Boeing 707 and Douglas DC-8.

• **Allison T56 turboprop.** Overhaul time has been extended in service on the Lockheed C-130 from 50 hr. to 300 hr. Power package can be changed in three hours by three men. The T56 will be used in the Lockheed Electra.

More than 100 representatives of the airlines, Civil Aeronautics Administration and USAF commands attended the meeting. Newest power unit to get attention was the J79, which has a 17-stage single spool compressor with variable controlled stator blades in the first seven stages.

There are 10 combustion chambers, an annular transition section and a three-stage turbine. In view of the flexibility of the engine caused by the sheet metal design, vertical assembly and disassembly is being done at overhaul facilities. Horizontal methods are being used for field activities.

Limited studies of horizontal methods have shown that 50% more manhours are required than that needed for vertical assembly. There also are indications that horizontal tooling costs at least 45% more and weighs at least 50% more than vertical tooling because of size and design.

Only three engines have been reconditioned and actual time factors for the various overhaul phases have not been compiled. Cost for overhaul, according to R. M. Harrison, OCAMA jet engine technician, is about $71,000 per engine.

To overhaul 50 engines a month using a two-shift operation requires an estimated 150,000 sq. ft. of floor space. Inspection of the combustion chambers requires about 40 manhours, according to Harrison. Replacement and rigging of the main fuel control takes about 80 manhours.

"Today," Harrison said, "we can say that if our combustion chambers and nozzle diaphragms were looked at after 20 hr. of flight time the majority would require rework or replacement prior to further service."

Harrison said these conditions are being corrected through parts redesign and that by October 1957, J79 hot-section parts should be as good as those in other engines.

Referring to commercial jet operation generally, Harrison cautioned:

"Operate on temperatures as low as you possibly can and by all means do not live with metal bellows in the various cooling, anti-icing and oil system lines."

Metal bellows have been a sore spot in USAF jet engines generally. There are nine on the J79, and they fail frequently, Harrison said. The trouble stems basically from vibration.

Wait for Data

W. C. Espolt, OCAMA logistics support planner, told the meeting that, if the T56 or J79 engine are to be seriously considered for commercial use, the engine contractor's facilities should be utilized for overhaul with contractor-furnished parts until "such time as special tools, technical information, spare parts support and parts consumption data have been firmly established and made available."

Highlights of OCAMA's Pratt & Whitney J57 overhaul and maintenance were outlined by R. Vanderveer, jet engine technician, who pointed out out that the information now available to the engine manufacturer would be of considerable assistance in the preparation of commercial handbooks.

More than 13,000 engineering changes have been issued on J57 engines; they have resulted in publication of more than 225 service bulletins. More than 130 overhaul changes have been, or are in the process of being, published. About 70 maintenance engineering orders have been issued by OCAMA.

Elapsed time in overhaul is 31 days on a one-shift basis, while elapsed working time to completely overhaul the J57, including test, is 24 days on a one-shift basis.

Total space requirements for J57 overhaul, including storage, is 169,632 sq. ft. Cost of materials in overhaul of the average engine is $15,000, with a low range of $12,000 and a high value of $18,000.

Typical range of rejection for high-cost engine components is approximately 3% on an overall basis, except for compressor blades, turbines blades and turbine vanes, which is about 20%.

Facility Costs

Cost of building and equipping an overhaul facility capable of handling 50 engines a month is estimated at $4,270,000. This would include such items as $1,307,000 for equipment and tools (including standard hand tools); $620,000 for accessory overhaul and test; $300,000 for three-unit test cells and $300,000 for test tools and equipment.

Experience at Castle AFB, Calif., for the first year of Boeing B-52 operation reveals that there were a total of 61 J57 engines prematurely removed. Causes were eight for high exhaust gas temperature, 13 for foreign object damage, seven for turbine section damage, eight for oil leaks, three for oil system malfunction, five for nozzle guide vane damage and 17 for miscellaneous damage.

From June 29, 1955, to Oct. 18, 1956, the B-52s have chalked up 10,134 hours of operational flight time. This is equivalent to 81,072 engine hours. Until June 1956, time before overhaul was 500 hr. This was later increased to 600 hr. and, just this month, boosted to 800 hr.

One major problem with the J57, Vanderveer reported, is that of oil leaks at No. 6 bearing sump and coking of oil in the sump cavity. Coking is more pronounced on afterburner engines because of additional heat generated at this point.

A change has been instituted to provide a heat shield around the sump, and this has delayed coke buildup. Engine oil is changed every 200 hr. Development of an oil that would withstand higher temperatures might eliminate the coking condition.

While foreign object damage remains a predominate cause for removal of the J57, Vanderveer points out the record of the engine is relatively good, and percentage of removal is smaller than originally expected.

Air Force experience with all types

of gas turbine engines indicates that approximately 40% of all removals is due to foreign object damage. J57 removals for foreign object damage, however, are approximately 20%.

Periodic inspection of the B-52 with the J57 engine without afterburner was originally established at 100 flight-hr. intervals. This was recently increased to 200 hr. of engine operating time.

This increase, however, is contingent upon an exhaust gas temperature check and a fuel pressure differential check being conducted at each 100-hr. interval to determine fuel manifold and nozzle condition.

Periodic inspections include a check of the hot section, which reveals the internal condition of the engine. Removal of the engine from the aircraft is required, and the estimated time for a hot-section inspection is 28 manhours.

Boeing has introduced a change with respect to installation of the J57-P43W to embody swing-out provisions. If the change is approved, it is expected to save between two and four manhours of inspection time.

Overhaul Time

Vanderveer reported that, in the hot section inspection, combustion chamber allowable crack limit is 1¼ in. Estimated time for overhaul during a periodic inspection of the J57 is 50 manhours, or about two days of elapsed time.

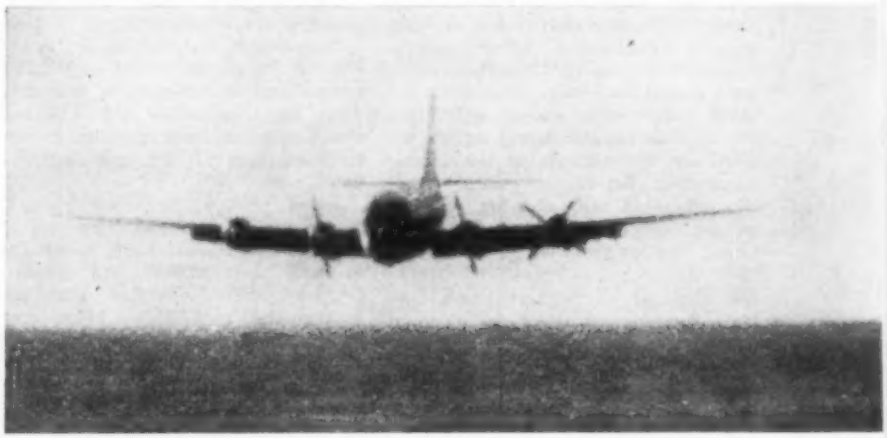
As an indication of what a periodic inspection can reveal, Vanderveer reported on the period between June 1 and Aug. 31, when 17 aircraft with A-series engines J57-P1 and P9 underwent periodic inspection. Based upon 100 hr. of operation between inspections, this represents 1,700 aircraft hr., or 13,600 hr. of engine operation for the eight engines.

During the hot-section inspections of the 136 engines, one engine was rejected for bowed first-stage nozzle guide

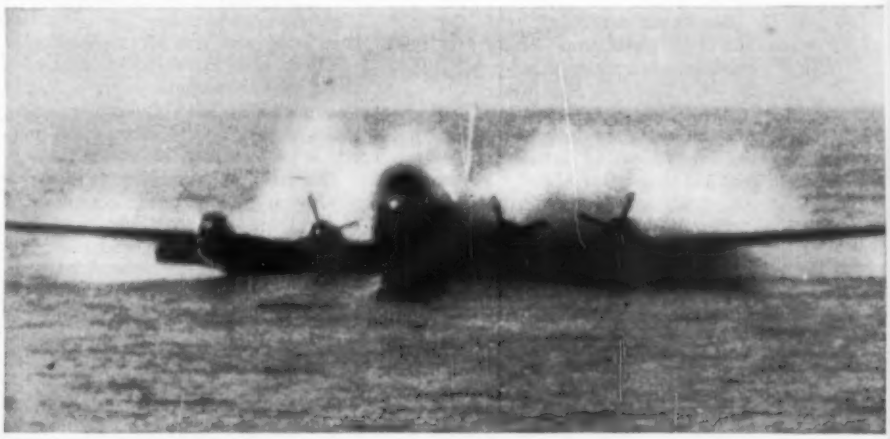
Stratocruiser Is Ditched

Pan American World Airways Boeing Stratocruiser was ditched midway between Honolulu and San Francisco Oct. 16. Five hours out of Honolulu No. 1 propeller began to overspeed, and when the engine was stopped the propeller uncoupled and continued to windmill. No. 4 engine lost power, and Capt. R. N. Ogg decided to shut it down and ditch by weather ship "N" the Coast Guard cutter Pontchartrain. Capt. Ogg circled nearly five hours waiting for daylight, burning fuel. Cutter laid strip of fire extinguisher foam on sea to calm seas and help pilot's depth perception.

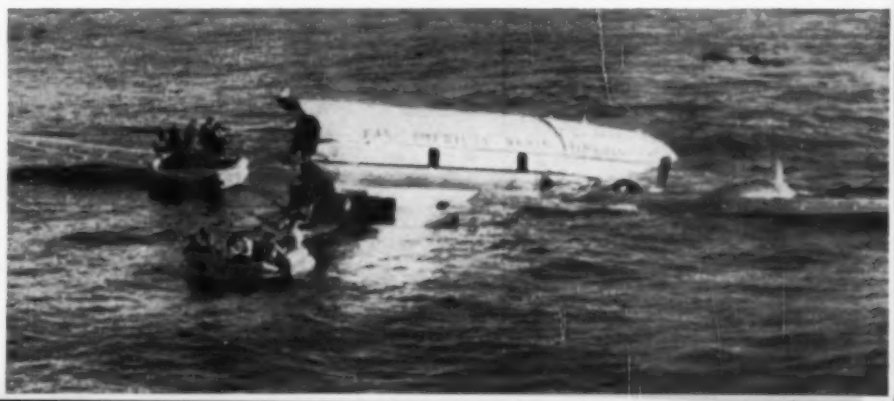
NO. 1 PROPELLER windmills. No. 4 is feathered as Stratocruiser glides toward water.



TAIL section broke away when Stratocruiser landed. Note tail-down attitude (below).



AIRCRAFT floated 26 min., allowing 24 passengers and seven crewmen to get into rafts.



vanes and two for stripped combustion-case bolts. Sixteen combustion cans also were rejected.

Over the same period, 11 aircraft with B-series J57-P29W underwent periodic inspection. During 88 hot-section checks, no engines were rejected, but 24 combustion cans were.

From June 30 to Sept. 7, six A-series engines were prematurely removed in addition to those taken out at periodic inspection. Two were rejected for excessive exhaust gas temperature, two for oil leaks at No. 5 bearing, one for a cracked inlet duct and one for fuel-control malfunction. During the same period, only three B-series engines were prematurely removed—two for oil leaks and one for oil-soaked electrical wiring.

Vanderveer also outlined the reasons for a special inspection. Should the exhaust temperature exceed 610C for five seconds or less during starting or 650C for five seconds or less during acceleration but fail to exceed 760C, the engine is inspected for evidence of rubbing or damaged blades or vanes, free rotation of high and low stage compressor rotors (with no audible evidence of circumferential contact), for nicks, dents or distortion of compressor rotors; cracks, heat damage, excessive buckling or warping of burner cans. If the temperature mentioned exceeds the five-second time limit, the engine is removed.

T56 Experience

Air Force experience with the Allison T56 turboprop engine in field maintenance and overhaul was outlined by OCAMA's R. E. Durkee.

As of Oct. 1, approximately 150 major engineering design changes had been incorporated into the new production engines. About 55 of these have required modification of the earlier production engines.

Reduction gear assembly can be replaced in approximately two hours by three men. Torquemeter assembly, which does not require overhaul at any specified period, can be replaced by three men in approximately three hours.

Although several thousand flying hours have been chalked up on the T56, very little actual field maintenance repair has been done. This is because the engine and the Lockheed C-130 it powers have not yet been released for organizational operation. A field maintenance program will be implemented at one base in December.

At the present time, the complete turbine rotor assembly has to be replaced as a unit whenever a turbine blade or assembly component part is damaged beyond limits. This is because the design requires assembly under high pressures.

Also, very little welding of combustion section parts is now permitted, because sufficient experience is not yet available to establish maximum limits. Replacement of the compressor rotor cannot be accomplished at field level, although blending of minor nicks and dents in specific areas of the rotor blades can be done.

All external parts and accessories can be replaced. Reduction gear repair is very limited, with the safety coupling being the only internal part permitted to be replaced except at overhaul.

Torquemeter Repair

The torquemeter can only be repaired at the overhaul depot. Experience indicates that the major trouble areas in the engine will be in the fuel system and reduction gear assembly. Thus far, overhaul of the T56 and components has been restricted to contract overhaul at the manufacturers' plant.

As of Sept. 1, there had been 17 power units and 42 reduction gear assemblies overhauled. Each power unit overhaul costs $8,585, and overhaul cost for each reduction gear and torquemeter is $2,285. These costs include labor plant burden and manufacturer's profit.

It is expected that the San Antonio Air Materiel area will be ready to overhaul the T56 early in 1957. Inspection requirements of engine parts, particularly those subjected to high heat and fatigue concentration, have been and still are a problem.

These parts in the T56, as well as those in other engines, are inspected by magnaflux and fluorescent penetrant methods, considered best methods available.

Overhaul of the reduction gear assembly is much more complex and costly than the procedure used for a reciprocating engine reduction gear. High horsepower and speed reduction involved call for closer fits and clearances.

Many of the major components of the reduction gear assembly are manufactured as complete matched sets and when one part is damaged, the complete matched unit must be replaced.

Highlights of jet accessory overhaul and test were presented by L. M. Cook, who pointed out that it required 40 manhours to make a J57 fuel control serviceable.

A jet engine fuel control test stand costs $75,000 as compared with $10,000 for a carburetor test stand. About 240 training hours are required to operate a jet engine main fuel control stand as against 20 training hrs. for a carburetor test stand.

It requires approximately 720 hr. to train a test bench operator to calibrate a jet main fuel control as compared with 240 hr. to train for calibrating a carburetor.

Approximately 162 manhours are required to overhaul and test the J57 engine accessories. As an example of one unit, Cook cited the JFC-12 model main fuel control which requires about 24 manhours for the overhaul sequences as compared with 16 manhours for the piston carburetor.

For test of the control about 16 manhours are required. Approximately 12% of fuel controls are rejected during calibration and an additional 2% are rejected at time of engine test.

Two types of overhaul are presently being utilized—progressive overhaul and individual overhaul. The type or combination of types selected is left to the discretion of shop management.

The J57 fuel control overhaul is being accomplished now by the individual method. The mechanic initiates and completes the entire sequence.

Static Testing

Although future testing of accessories may be accomplished through dynamic type testing, all present accessories are tested under static conditions which artificially produce the engine operating conditions used as metering parameters.

Basic rule for static testing is the elimination of all possible variables. Hence, test equipment has been designed to give extreme accuracy for the manual setting of specific test conditions.

For example, main fuel control rpm. is set manually for ¼ of 1% accuracy. Fuel temperature specific gravity and viscosity are maintained to specific limits. Total flow to the fuel control is manually controlled to an accuracy afforded by the best available flow meter equipment.

News Digest

Prof. Daniel Clemens Sayre, 53, associate dean of the Princeton University School of Engineering and director of the James Forrestal Research Center, died Oct. 19. He was assistant editor and later associate editor of AVIATION MAGAZINE from 1933 to 1939. The magazine was later combined with four others to form AVIATION WEEK.

Office of Naval Research has scheduled the first high-altitude flight of its manned space laboratory (Strato Lab) to collect stratospheric data at a site adjacent to the University of Minnesota. The Strato-Lab, with two observers, and attached to a Skyhook plastic balloon, is expected to reach an altitude of 75,000

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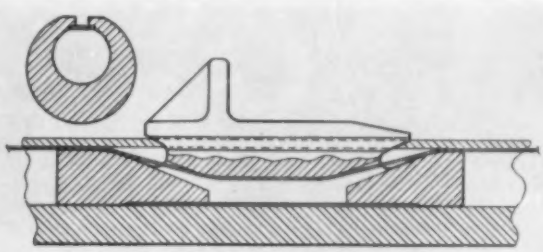

Schematic of longitudinal section indicates how free piston guides sealing ribbon against tube slot.

Kelsey-Hayes Products

automotive: Wheels, Brakes, Hubs and Brake Drums, Power Brakes, Hydraulic Brakes, Transmission Bands, etc.

aviation: Jet Turbine Wheel and Compressor Rotor Assemblies, Blades, Buckets and Vanes, Power Recovery Units, Helicopter Transmissions, Actuators, Accessory Gear Assemblies, Bomb Hoists and Gun Turrets, Radar Tracking and Scanning Assemblies.

agriculture: Tractor and Implement Wheels, Wagons and other Farm Implement Components.

Expansion of plant, production and engineering facilities is part of the Kelsey-Hayes program to better serve the automotive, aviation and agricultural industries. This year alone, Kelsey-Hayes has acquired two new subsidiaries—with a total of five plants—in the aviation field.

This means an increase in both capacity and capabilities.

Jet turbine components, for example, can now be produced in far greater quantities. But equally important, they can be produced by all the accepted methods of the industry—according to individual needs and specifications.

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Sidewinder for FJ-3

Navy's Sidewinder air-to-air missile is operating in the Western Pacific on North American FJ-3 Furies of Fighter Squadron 211. Squadron is aboard the USS Bon Homme Richard with Seventh Fleet. Aerodynamic research program incorporating this 9 ft. missile which is effective to altitudes over 50,000 ft. was test flown from Columbus,Ohio, where Columbus Division of North American produces FJ-3. Missile also is operational with Atlantic fleet units (AW Oct. 22, p. 33.)

ft. The scheduled flight date is Nov. 1.

Navy awarded a $23 million contract for production of launching equipment for the Terrier guided missile to Northern Ordnance, Inc., of Minneapolis. Launching equipment provides for automatic loading, enabling instantaneous firing of the missiles by the fire control system.

Three weeks of testing on a wartime basis will end Nov. 15 for the Strategic Air Command's fighter units. First of five Republic F-84 wings arrived at Offutt Air Force Base, Neb., last week for bombing and navigation exercises.

Temco TT-1 primary jet trainer technical and evaluation tests were completed by a team of Royal Canadian Air Force officers. Trainer already has been selected for use as U.S. Navy's first primary jet trainer.

Canadair Ltd., Montreal, will build 24 Mk. 4 F-86 Sabres for Israel. Sale, approved by Canadian government, also includes spare parts, totals $7.2 million. Delivery will begin next month.

Pratt & Whitney Division, United Aircraft, contracted with Horizons Inc., Cleveland materials and process research organization, for testing and development on aircraft nuclear propulsion procedures.

Republic RF-84F Thunderflashes won high and low altitude photography contests in competition between allied Second and Fourth Air Forces. Photography at more than 30,000 ft. was won by Lt. Michel Duhaumont of 33rd Tactical Reconnaissance Squadron of French air force. Under 1,000 ft. competition was won by Lt. John L. Roberts of U.S. 66th Reconnaissance Wing. Competing aircraft included English Electric Canberras, Vickers Swifts and Martin RB-57s.

TRADCOM (Army Transportation Research and Development Command) has been redesignated TRECOM (Transportation Research and Engineering Command). TRECOM recently became responsible for all Army aviation engineering activities and transportation corps standardization.

Minneapolis-Honeywell Regulator Co. Aeronautical Division received $6,883,000 contract to supply low altitude bombing systems (LABS) to Navy. Company also supplies systems to USAF. System enables fighters to lob bombs, including nuclear weapons, from tight loop and escape blast area.

Lawrence D. Bell

Buffalo, N. Y.—Lawrence D. Bell, 62, founder and board chairman of Bell Aircraft Co., died of a heart attack on Oct. 20.

Bell began his aviation career as an aircraft mechanic with the Glenn L. Martin Co. in 1912. He later became general manager and vice president of the firm. He joined Consolidated Aircraft Corp. in 1928, and served with the company as sales manager, general manager, and vice president until 1935, when he founded Bell Aircraft. For his pioneering work in aircraft development, Bell received the Collier Trophy, the President's Certificate of Merit, and the French Legion of Honor.

Airline Growth Indicates Healthy Profits

Third-quarter trends point to 14% gain in traffic for 1956 despite slow start in travel last summer.

By Craig Lewis

Washington—Gains in airline traffic made during the past summer show that the industry is continuing a 1956 pattern of steady growth that should give the carriers a healthy profit margin by the end of the year.

After a disappointing start, summer-season traffic picked up in August and September, and the trend through the first half and third quarter of 1956 indicates that airline traffic will show a 14-15% gain this year.

Profits for the industry as a whole are not growing as fast as traffic and revenues because of rising cost levels and continued dilution of unit revenues, as well as the extraordinary cost situations faced by a few carriers. Indications, however, are that profits will at least maintain their 1955 levels.

Trunk airlines are showing a lower rate of growth than international and local service carriers, although their total gains are greater. Trunk line traffic has averaged a fairly steady year-long growth of about 13%, in terms of passenger-miles, over last year.

International Gains

International airlines marked up substantial gains this summer after a disappointing start in July. Across the Atlantic, for instance, Pan American World Airways' traffic increased only 6% in July, then gained 23% in August. Trans World Airlines' increases were 2% and 14% for the same months.

In the Pacific area, Pan American's traffic increased 23% in the first eight months of the year, and Northwest's traffic was up 15%. Since Pan American increased capacity only 19% and Northwest made no capacity increases, these gains have improved load factors.

The local service airlines continue to grow faster than their older, larger colleagues, but the rate of growth is tapering off somewhat. Thus far this year, feeder-line traffic has grown about 22%. Increases in capacity, including introduction of Convair and Martin transports, also has slowed the growth of load factors.

The trunk airlines went into the third quarter of 1956 riding the crest of the greatest traffic month they had ever experienced. The June traffic, was far above expectations and drove the industry load factor up to 73.2%.

After this experience, July traffic was a sad comedown. During this first month of the third quarter, traffic grew only 6.7%, a rate far below the year-long average growth.

July Traffic Drop

The carriers blame this traffic dip on various factors, including the month-long steel strike which cut into business travel, and the fact that the Fourth of July holiday came during the mid-week, cutting vacation travel.

Undoubtedly, the major factor in the July traffic situation was the collision over the Grand Canyon between TWA and United Air Lines transport on June 30.

Traffic picked up again in August. Where July load factors dropped from 67.2% in 1955 to 63.2% in 1956, August load factors averaged 66%—about the same as August 1955. And these August load factors were maintained in the face of a 15% increase in capacity. The favorable trend continued in September.

Air-coach traffic is making substantial gains this year following a slow year in 1955. Last year, coach traffic was just under 35% of total trunk line passenger-miles. In the first eight months of 1956, the coach share of the market moved up to 39% of the total, and it may grow to 42% by the year's end.

Coach traffic made substantial gains even in July, when it increased 11% over July of 1955. It was up 19% in August and 18.5% in the first eight months against an overall traffic increase of 12.6% for the eight-month period.

This increase in coach traffic means continued dilution of revenues. As more passengers buy low-fare coach tickets, the average fare yield per mile decreases. Along with this, expenses are continuing to rise as fast, or faster, than revenues. These factors keep profits from growing as fast as revenues and traffic, with the result that profits tend to stay at the same levels while other categories are rising. In spite of this trend, the profit position of most of the trunk carriers is healthy.

The airlines' prospects for the fourth quarter and for the first part of next year continue to look good, basically because prospects for the national economy look good.

As expected, the national economy leveled off somewhat in the third quarter. Although the Gross National Product showed a substantial increase, the increases were mostly in prices rather than business activity.

Now, business activity is moving up again in the fourth quarter, and the rise is expected to continue into the first quarter of 1957. The rise in activity is being led by industry's capital spending, although consumer spending is lending powerful support.

While the airlines depend heavily upon the consumer's enthusiasm for spending, the increase in capital spending is good news, too, because this business spending is the type that promotes more business travel.

First third quarter reports from trunklines show varied results. American Airlines reports total earnings of $17,078,000 for the first nine months of the year, including $1,317,000 from sale of aircraft. Profit for the same period last year was $14,337,000.

American's total revenues were up 11.5% in the first nine months to $217,281,000. Traffic increased 13% to 3,697,054,000 passenger-miles.

United Reports Gains

United reports similar gains. Earnings to Sept. 30 were $11,385,844, including a $1,272,888 gain from aircraft sales. Earnings for the 1955 period were $10,011,309. The airline's profit in the third quarter was $6,124,960, compared with $5,739,229 last year.

United's revenues increased 9% in the third quarter and 12% in the first nine months for totals of $73,927,840 and $200,380,900. Expenses rose 11% and 13% in the same two periods, but the airline says unit expenses have actually been kept below 1955 levels.

Passenger traffic was up 10% on United's system in the third quarter and gained 13% in the first nine months of the year. United coach traffic made the bulk of the gains, with a 31% increase in the first nine months of the year. First-class traffic gained only 5%.

Delta Air Lines reports revenues up 16.7% to $17,335,000 in the July-September period, although net income slipped from $635,923 in the 1955 quarter to $485,858 in the 1956 period. September revenues increased 20% and net earnings for month were up 14%.

Delta points out that 19% of the seat capacity it operated in the quarter was in the new Washington and New York markets which the carrier is still breaking into. The usual winter traffic increases are expected to improve

Delta's overall profit situation.

Capital Airlines remains one of the few trunklines not reporting favorably, although the carrier thinks it has turned the corner on its expansion program and will soon begin to show up in the profit columns.

In the first nine months, Capital had an operating loss of $1,571,000, compared with an operating profit of $945,842 in the 1955 period. The addition of special charges brings the loss to $3,200,000 for the nine month period.

Viscount Capacity

Capital has faced two sets of extraordinary charges in the past year. Introduction of the Viscount was expensive and, in addition, represented a net gain in capacity, since the airline still operates most of the DC-3s, DC-4s and Constellations it had before the Viscounts were delivered. This added capacity has served to keep system load factors down, although Capital has registered spectacular traffic gains—37% in September.

The second expense has been expansion of service facilities for the new routes Capital in effect received when the Civil Aeronautics Board rearranged the carrier's route structure in a series of route cases.

Capital had an operating profit of $440,000 and a net profit of $59,000 in September, and the carrier hopes these gains mark the end of the period of heavy losses which came with the expansion program. Since the fourth quarter is usually a lean traffic period for Capital, the airline expects to break even in this period and finish the year with the $3,200,000 loss registered in the first nine months.

Capital's hopes for future profits are pinned to the Viscount, and figures for the first eight months of the year tend to support the carrier's faith in its turboprop transport.

Capital reports that in the first eight months, its fleet of 21 DC-3s operated at a $2,000,000 loss, the 14 DC-4s lost $900,000 and the 12 Constellations lost $1,300,000. In the same period, Capital says its Viscount fleet contributed an operating profit of $2,350,000 to help offset losses from the piston engine transports.

BOAC Can Buy 707s

London—British government last week gave permission to British Overseas Airlines Corp. (BOAC) to buy 15 Boeing 707s.

The planes, for use on the North Atlantic route, will be powered by Rolls-Royce Conway bypass jet engines.

Harold Watkinson, Transport and Civil Aviation Minister, made the announcement in the House of Commons.

The planes and initial spare parts will cost 44 million pounds ($123,200,000), of which more than two-thirds will be in dollars.

Transatlantic Traffic Increases

New York—Scheduled traffic over the North Atlantic during August and September showed a 20% increase over the same months last year, bringing the May-September total increase to about 16% over 1955. This improved the slower picture presented earlier in the season (AW Sept. 3, p. 40).

The transatlantic airlines carried 191,900 passengers during August and September 1956 to raise the season total to 442,900. Last May-September the count was 384,000 passengers.

Good load factors during the last two months reduced the earlier spread between capacity and payloads. Seats available during the five months totaled 664,900, 22% over the previous year. Overall load factor in both directions for the season averaged about 66.5%.

Tourist passengers continued to provide most of the increases; 341,500 tourist travelers were carried in both directions, with the remaining 101,400 passengers riding first-class. Over the five months, the airlines filled considerably more westbound than eastbound seats.

This imbalance in favor of the westbound traffic increased sharply over last summer's distribution.

- **Last year's** passengers divided 197,400 westbound, 186,600 eastbound, a difference of about 5%. This year, westbound total was 233,800 passengers, eastbound was 209,100, a 12% spread in favor of the westbound movement.
- **During the 1956** season, eastbound first-class passenger totals showed no gain; tourist totals were up 15% over 1955. Westbound, first-class traffic increased 8%, tourist traffic was up 22%.
- **Eastbound seats** available increased 10% in first-class and 26% in tourist class; westbound increases were 9% and 27% respectively, relating more closely to the passenger increases.

Month by month, the 1956 summer traffic developed as follows:

- **Eastbound** May 36,000; June 62,000; July 51,000; August 31,600; September 28,500.
- **Westbound** May 27,000; June 32,000; July 43,000; August 65,800; September 66,000.
- **Both directions** May 63,000; June 94,000; July 94,000; August 97,400; September 94,500.

Airlines, most of them offering a variety of tours geared to the International Air Transport Association 15-day excursion fare which went into effect Oct. 1 (AW Oct. 22, p. 39), are watching their October traffic statistics closely to gauge the initial effect of the plan in cushioning the off-season drop this month.

Last year, with the old off-season rates effective Nov. 1 through Mar. 31, traffic dropped off from 79,301 passengers in September to 50,700 in October. The 15-day excursion fare is good all year round, and the airlines also have retained the family plan rates, good Nov. 1 through Mar. 31 though not in conjunction with the excursion fare.

Jet Age Study Group Organized by ICAO

Montreal—International Civil Aviation Organization last week announced the formation of a six-man jet age task force to survey air navigation requirements for jet transport operations.

The panel's study will include recommendations for installing additional airways facilities which may be required between now and 1961 in anticipation of jet transport operations without restricting normal schedule patterns.

The task force also will consider ways of assisting any nations which, for either technical or financial reasons, may be unable to provide necessary new facilities. Task force members are:

Col. Luis de Azcarraga, director of flight safety, Spain; Col. Helio Costa, director general of airways, Brazil; A. P. Dekker, deputy director of civil aviation, Netherlands; Jerome Lederer, managing director of the Flight Safety Foundation, U. S.; Rene Lemaire, president, Council on Auxiliary Services and Air Navigation, France; Air Vice Marshal Sir Victor Tait, chairman, International Aeradio, United Kingdom.

R3Y-1 Makes Record Seaplane Crossing

San Francisco—Navy Convair R3Y-1 turboprop tanker seaplane has made a Honolulu to San Francisco crossing in 6 hr. 45 min.

Time was more than three hours faster than previous seaplane mark of 10 hr., 21 min. set in 1948 by the Caroline Mars, but was 34 min. slower than flight of 6 hr. 11 min. made by a United Air Lines DC-7 last year.

The Indian Ocean Tradewind, which is one of three assigned to VR-2 at the Alameda Naval Air Station, averaged 355 mph. with a 21 kt. tailwind. The three R3Y-1s and four R3Y-2s delivered to the squadron to replace the Mars seaplanes have not yet been assigned a mission and are being used for training.

Airways Development Plans Keyed to Jets

By L. L. Doty

Indianapolis—Civil Aeronautics Administration's Technical Development Center has keyed its evaluation and testing program to jet transport operations, with primary emphasis being placed upon airways and air traffic control development.

The immediate need for improved and expanded airways to handle increasing traffic demands, fit into the CAA's three-year federal airways plan and provide for the dovetailing of jet transports and slower, piston-engine traffic was emphasized last week at the Radio Technical Commission for Aeronautics' 1956 Fall Assembly at Weir Cook Airport here.

The RTCA survey of TDC facilities constituted a progress report on air navigation and air traffic control development and the methods used for evaluating the tests. Principal subjects covered included:

• **Air Traffic Simulation.** The TDC dynamic air traffic simulator is a laboratory device combining optical, mechanical and electronic equipment with the human factor in the control of traffic.

• **Air Traffic Control.** Coordination Equipment is undergoing research and development directed toward the production of a semi-automatic system for air traffic control.

• **ATC Radar Beacon System** has received intensive technical and operational evaluation tests on equipment furnished by the Navy under contracts sponsored by the Air Navigation Development Board. In-service tests will be conducted during 1957 at New York, Chicago and Washington.

• **Airways Operations Evaluation Center** is a laboratory facility to evaluate new ATC equipment and procedures in a systems environment.

How Simulator Works

The dynamic simulator gives TDC an opportunity to study new procedures and observe human reactions in the system's operation. The simulator consists of a large movie screen on which is projected a map of the air traffic control area under study. Eighteen controllable dots of lights are superimposed on the screen to simulate aircraft.

Each dot is projected by one of 18 motor-driven projector units remotely controlled from individual pilot consoles governed by a woman operator. Operators control the speed and heading of the dots which make standard-rate turns to correspond to the movement of regular aircraft in a traffic pattern. Climbs and descents also are simulated at a realistic rate.

The screen display is televised to radar scopes observed in another room by air traffic controllers handling en route and terminal operations. These simulated radar displays are presented by means of a rotating sweep. Interphones connect controllers with pilot console operators, enabling the controllers to communicate with the simulated aircraft and supervise stack turn-offs and approaches as though operating under regular conditions.

An important objective of the simulator tests is to develop a system that will accommodate jet transports without the need for priorities or special privileges.

It has been determined through simulator experiments that jet traffic can be handled with greater safety, less controller work and less delay for all traffic if holding patterns are removed from the final approach course, a procedure already in use at several airports.

The simulator has taught Technical Development Center personnel that a twin-stack feeding system is necessary if the airport acceptance rate is to exceed 20 approaches per hour. Furthermore, it has been learned that holding patterns must be sufficiently clear of the final approach to allow room for adjustment of approach intervals and permit aircraft to make easy turn-offs to the final approach course without overshooting.

Adequate Distances

Pre-tabulated tables of adequate distances between aircraft of different speeds are recommended for each controller as a result of the simulator tests. Observations also indicated the desirability of grid markings on map overlays as a reference for the controller in judging optimum spacing of aircraft on the final approach path.

The air traffic control coordinating equipment project involves a research and development program for a semi-automatic system for collecting, storing, processing and displaying flight information for controllers' use. The TDC is producing an experimental program that is being evaluated under simulated conditions and that will be implemented at any development stage demonstrated to be practical.

The program is being conducted in a three-phase approach.

Phase One is aimed towards reducing personnel work in collecting and displaying flight information. The Technical Development Center hopes to ease or eliminate this effort by the automatic printing of flight progress strips (now hand-written) and automatic transfer of data from one center to another. Equipment requirements for Phase One include:

• **Teletypewriter-communications** system for collecting flight plans.

• **Flight plan input device** for fast and accurate composition, checking and transmission of flight plans.

• **General purpose computer** that will check accuracy of flight plan, divide

AIRWAYS simulator has map of traffic control area projected onto large movie screen.

NEW procedures and human reactions can be studied with simulator at center.

flight plan into a series of fix-posting messages, compute estimates and send to appropriate printer.

- **Automatic printers** for reproducing flight-progress strips in standard form.

Phase Two provides for automatic display and automatic revision of flight data. In addition to equipment needs under Phase One, an electronic device that will display information now carried on flight progress strips by projection techniques—or by means of a charactron or typotron—will be required.

Phase Three moves into the application of fine grain position information. (That produced by radar, air-ground data links or telemetering techniques.)

System requirements in addition to those of Phase One and Two are:

- **Radar-data link.**
- **Air-ground data link.**
- **Filtered pictorial-situation display.**
- **Fine-grain computing system.**

Under a project sponsored by the Air Navigation Development Board, a magnetic drum message storage and processing unit and automatic flight data displays have been developed. Combined with an automatic teletypewriter switching center, this equipment is being evaluated by the Technical Development Center in the application of parts of Phase One and Two of the proposed semi-automatic system. Lack of funds, however, has prevented the inclusion of any computing functions.

Using trained operators as a substitute for a general purpose computer with the drum and automatic displays, as many as 60 aircraft per hour were handled at two sectors of the Indianapolis area in a simulated operation.

Radar-beacon-system equipment furnished to TDC for test purposes have characteristics that are compatible with common system requirements but are not considered prototypes.

Compatibility of the beacon system is a major advantage, since it eliminates the need for aircraft carrying two types of transponders. However, this feature is also a major disadvantage since unlimited ground implementation adds fruit to ATC displays.

Tests of a delay-line type of defruiting equipment developed by the Naval Research Laboratory have been made at TDC which demonstrate that defruiting equipment can be effective.

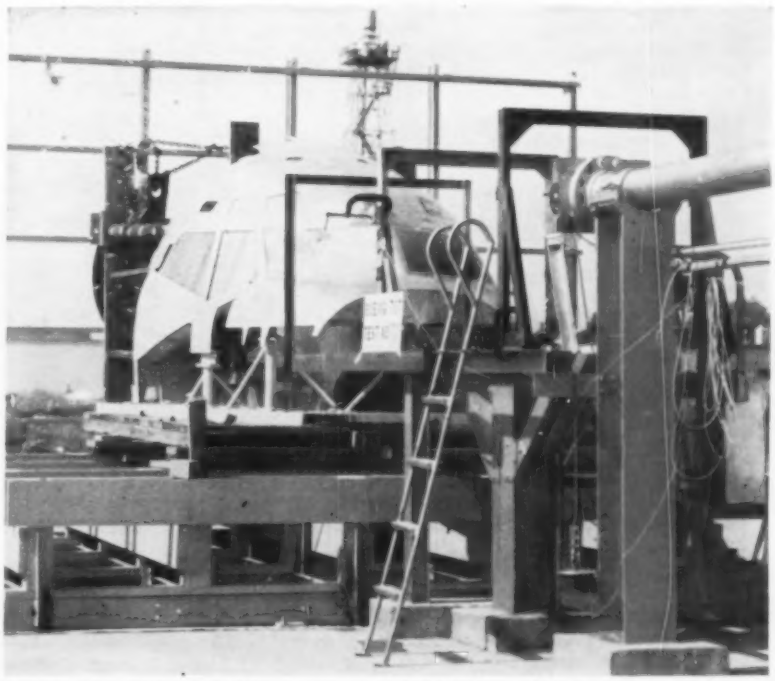
The Airways Operations Evaluation Center program is divided into two major efforts at the present time. The first stage, an immediate program, is the study and evaluation of a complete radar system. The second part involves the evaluation of the semi-automatic system. Both stages of the program will include studies of airway and air space structure and an analysis of rules and regulations.

The center also is analyzing the effects of birds striking the windshields of high-speed aircraft through the use of a compressed air gun that will propel the body of a chicken up to speeds of 2,000 mph.

Components of the gun include a compressor and related equipment that provide an air supply of up to a maximum 500 psi., two large tanks for storing air under pressure, a rapid-acting discharge valve, a loading breech and a 41-ft. barrel six inches in diameter.

Windshield panels of a Boeing 707 were recently tested against bird velocities of up to 450 mph. While no penetration of the laminated windshield occurred, inner and outer layers of glass were shattered.

Similar tests were performed on an Allison T56 turboprop engine. A chicken body fired into the air intake of the engine at a speed of 300 mph. caused no damage to the engine.



AIR GUN to shoot 4-lb. chicken carcasses at windshields can simulate 2,000 mph. speeds.

California Eastern May Purchase Convair 880 for Overseas Routes

By Glenn Garrison

New York—California Eastern Aviation may soon order Convair 880 jets for short-range domestic and long-range overseas use.

Jorge E. Carnicero, board chairman of the contract carrier parent company, sees "tremendous potentialities" in the versatility of the medium-range transport, is negotiating with Convair for the purchase of four aircraft.

The 880s, which probably would be delivered in late 1960 and early 1961, might go into service with the newly formed Argentine airline, Transcontinental, on a route to the U.S. and Pacific. California Eastern recently concluded a lease-purchase arrangement with Transcontinental whereby the American carrier will provide five Lockheed 1049Hs, temporary crews, training and maintenance.

Plans for Transcontinental, which is 75% owned by private Argentine capital and 25% by California Eastern, call for service to New York by summer 1957, to San Francisco by late 1958, and to Tokyo by late 1959, Carnicero said.

The Convair jet appears capable of carrying a 21,700 lb. payload San Francisco-Honolulu in its present design, according to Carnicero. California Eastern, which hopes to become a certificated airline through its application for Texas-California service in the Dallas-to-the-West Case, will definitely buy jets for its own operations, the board chairman said. He expressed enthusiasm for the 880's adaptability to various types of operation.

Guaranteed range for the Model 880 at a starting weight of 155,500 lb. is 1,475 nautical miles (AW Oct. 15, p. 57). Ranges quoted by Convair, but not yet warranted, include a 3,000 mi. figure with a load of 80 passengers, which is maximum all first-class load.

Financing for the jet transports will be available to California Eastern, Carnicero said. The Bank of America has loaned California Eastern 75% of the amount needed to buy the 1049Hs.

Carnicero predicted a number of further orders from major American carriers for the medium-sized jet.

The Argentine airline expects to begin Buenos Aires-New York service with three flights weekly next year, and to increase the frequency to five flights in early 1958. It will serve the intermediate points Sao Paulo, Rio de Janeiro, and Caracas on the route.

A bilateral agreement with the United States has not yet been obtained, Carnicero said, and that is the airline's next step. He expects no difficulty, because American carriers now offer frequent service to Argentina.

Transcontinental's projected route expansion to the Orient instead of Europe is necessary because Aerolineas Argentinas flies to Europe and the Argentine government doesn't want the new routes superimposed on the existing ones. But the Far East is an air transportation market with vast potential, according to Carnicero, who predicts that within three to five years the Pacific airlanes will be as busy as the Atlantic routes are now. Rising standards of living in the East and improved international relations with such countries as Communist China will contribute to this trend, Carnicero said. The new Argentine airline also hopes to exploit an expected increase in U.S.-Latin America tourist travel.

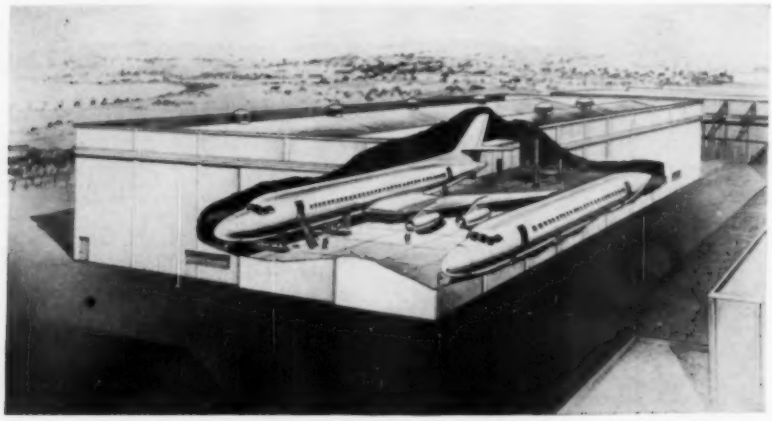
California Eastern now operates a fleet of 10 DC-4s, convertible between passenger and cargo operations, under military contract between the West Coast and Tokyo and transcontinentally. Three 1049Hs now on order for the carrier's own fleet are scheduled for mid-1957 delivery. California Eastern has a total of eight 1049Hs on order.

The contract carrier, which has logged more than 143,500,000 ton-miles in its ten-year history, is now the Airways Division of California Eastern Aviation, Inc. The parent organization has diversified its activities to include guided missile and other electronic work under government contract, primary flight training for the Air Force, sales, purchasing and ferrying service for U.S. and foreign aviation firms, and manufacture of X-ray equipment. It is considering acquisition of two more non-aviation firms.

The Airways Division also operates a maintenance and overhaul base at Oakland and plans expansion in this field. Financing is now being provided, according to Carnicero, for a new maintenance facility on the West Coast capable of handling jet transport aircraft. Duplicate facilities on the East Coast also are planned.

Award of a $1,859,000 Air Force contract to overhaul and modernize 115 Curtiss C-46 transports at the Oakland base recently was made.

The expansion of commercial aircraft fleets, including the introduction of jets, will bring an urgent need for increased maintenance facilities and services, Carnicero believes.



Convair Mockup Shelter

New $225,000 building to house detailed mockups of new Convair 880 jet transport was started recently. Building, measuring 200 ft. long, 100 ft. wide and 39 ft. high, will be of steel construction with reinforced concrete floor. It will house one full-sized fuselage, left wing, engines and tail assembly, with space enough for another fuselage. Preliminary mockups of the new jet have been under way for many months in a section of San Diego plant. Building will be ready early in 1957. Mockups will be used in sales programs.

Shortlines

▶ **American Airlines** is selling a new "Hit Shows of New York" weekend vacation package. The package includes tickets to three current Broadway shows, plus entertainment and accommodations at the Biltmore Hotel. Prices are $49 a person for three days, or $68.75 for four days, plus fare.

▶ **Lockheed Aircraft Service Corp.** has leased an extra six acres of land at Ontario International Airport, Ontario, Calif., bringing the LAS facility's total

to 113 acres. LAS has a current contract backlog of $30 million, most of it for work on military aircraft.

▶**Air France** is receiving a Super-G Constellation simulator from the Electronics Division of Curtiss-Wright Corp. this month and is scheduled to receive a 1649 Constellation simulator in 1957. The French carrier is building an $800,000 structure at Orly Field, Paris, to house the two Constellation simulators and future simulators for the Caravelle SE-210 and the Boeing 707.

▶**Canadian Pacific Airlines** is increasing its Vancouver-Honolulu service from two flights to five flights a week this winter.

▶**Fort Lauderdale's** airline ticket service will be improved in December when Delta Air Lines and National Airlines open a new $40,000 airline terminal building in the Florida city.

▶**Lufthansa's** district sales managers are in New York this week for their annual sales conference. They will discuss the German airline's plans for the coming year, including inauguration of new service to Vienna and Zurich, and extension of domestic services. . . . Lufthansa made its 1,000th Atlantic flight this month. In its first year and a half of operation, the carrier flew 50,400 passengers across the Atlantic.

▶**Mohawk Airlines** carried 32,546 passengers in September and 256,200 passengers in the first nine months of the year, an increase of 24.3% over the same period last year.

▶**North Central Airlines** flew 54,210 passengers last month, a 19% increase over September 1955, traffic. Traffic for the first nine months totaled 418,694 passengers.

▶**Pacific Northern Airlines** has begun construction on new airport terminal buildings at Cordova and Homer, Alaska, to handle passengers and cargo traffic. The Cordova facility will be shared by Cordova Airlines.

▶**Slick Airways** introduced DC-6A service to Boston, Hartford and St. Louis with its new winter schedules. The cargo carrier's new schedules increase its total daily airlift about 25%.

▶**Western Air Lines** is conducting a get-out-the-vote campaign with reminders mailed to passengers scheduled to travel on election day, warning them to file absentee ballots. . . . Western reports 30 flights already sold out for travel during the two-week Christmas holiday season.

AIRLINE OBSERVER

▶New York Airways will continue to schedule the S-58 with a single pilot until Civil Aeronautics Administration has further opportunity to study the one-man crew operation. CAA plans to make a decision next month on whether co-pilots will be required on the helicopter's passenger-carrying flights. Meanwhile, Air Line Pilots Assn. has protested the single pilot operation and has pointed out that Civil Air Regulations require two pilots on scheduled passenger aircraft weighing in excess of 12,500 pounds. ALPA admitted, however, that CAA has authority to issue an exemption to this requirement.

▶Germany and Brazil are revising and formalizing the provisional 1946 air agreement between the two countries. Final agreement may result in the addition of a second Brazilian airline operating into German airports not presently served by Panair do Brasil. Last August, Lufthansa began Super-G Constellation service into Rio de Janeiro and Sao Paulo to match the Brazilian service. Varig Airlines, which now services aircraft for Lufthansa, is making a strong bid for the European route.

▶Avianca plans to buy three DC-8s to replace its Super Constellations on long routes to New York and Europe. For shorter routes to Panama, Caracas and Quito, the Colombian airline plans to buy Vickers Viscounts equipped with Rolls-Royce R.Da. 7 engines.

▶Airlines serving Detroit are continuing to fight efforts to make them move from Willow Run Airport to Wayne Major Airport. Despite decisions by American Airlines and British Overseas Airways Corp. to move to Wayne Major, the other carriers serving Detroit are determined to stay at Willow Run and have launched a major face-lifting program for the airport's terminal. A $500,000 contract was signed this month for air conditioning and redecoration work.

▶Aeroflot's first European jet schedule consists of two Tu-104 flights each week between Prague and Moscow. The Russian carrier plans to expand the schedule to daily Prague-Moscow jet service in April 1957, and quick connections with Far East flights are planned in an effort to make the service competitive with present Europe-Far East services.

▶Civil Aeronautics Board has extended approval of Trans World Airlines' agreement with the Ethiopian government for five years. Under the agreement, TWA continues to be responsible for management of Ethiopian Air Lines' operations.

▶Czechoslovakia will buy Tu-104 jet transports from Russia in 1959 or 1960 for use on the Czech airline's long-haul routes, according to Czech President Josef Prohaska.

▶Civil Aeronautics Administration has proposed new regulations requiring minimum performance standards as established in Radio Technical Commission for Aeronautics' paper 225-55/DO-69 for newly-manufactured airborne VOR equipment. Proposed regulations also include minimum standards for new airborne radio receiving and direction finding equipment in accordance with RTCA's paper 83-56/DO-70. Ruling is to be effective November 30. Deadline for comments and suggestions is Nov. 17.

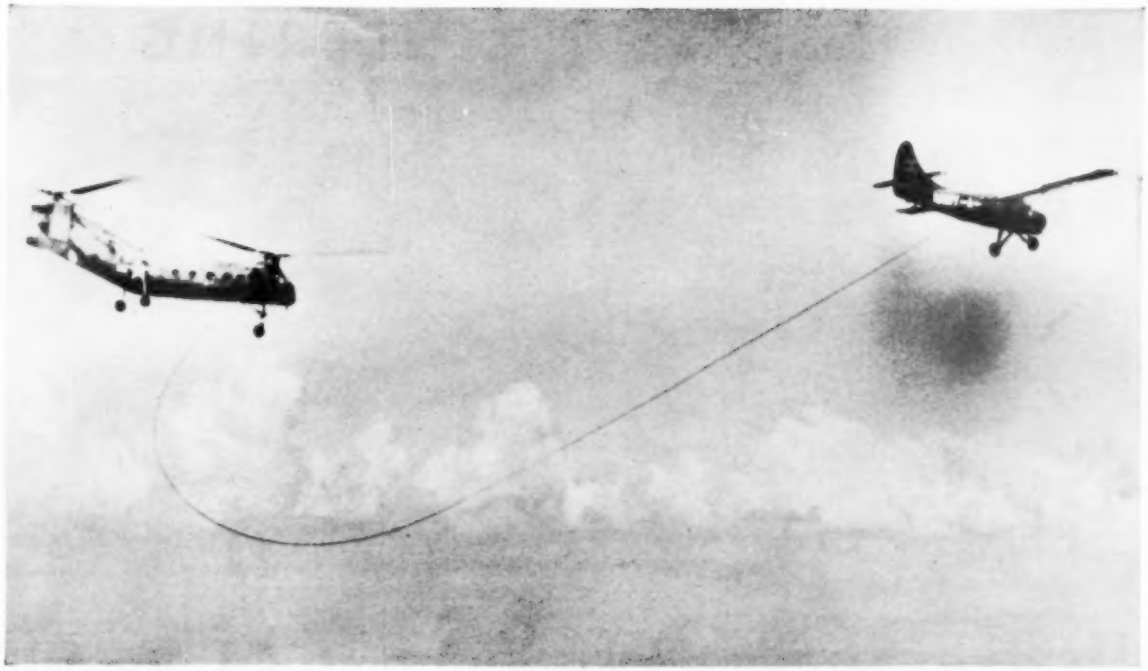
▶Negotiations between Italy and Germany on reciprocal landing rights have hit a stumbling block, although further discussions are scheduled for a later date in hopes of reaching a settlement on one key issue. Italy has offered Lufthansa landing rights in Rome and Milan but restricts traffic to that carried between Italian and German airports. After four days of hard bargaining, Italy still refuses to grant the German airline the right to carry passengers and cargo between Italy and other nations. Only Trans World Airlines and Pan American World Airways enjoy full Fifth Freedom rights in Rome at the present time.

Airline Income and Expenses—August 1956

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Subsidy	Total Operating Income	Total Operating Expense	Net Operating Income (before taxes)
DOMESTIC TRUNK								
American	$23,332,281	$546,164	$354,571	$1,409,361	.....	$26,022,120	$21,213,412	$4,808,708
Braniff	3,486,047	98,049	53,671	103,734	.....	3,827,262	3,509,257	318,005
Capital	5,675,888	109,479	79,058	91,834	.....	6,036,307	6,188,828	—152,521
Continental	1,499,441	37,996	41,951	36,814	$2,745	1,630,618	1,467,292	163,325
Delta	5,052,624	123,487	79,749	157,001	.....	5,524,238	5,188,855	335,383
Eastern	16,033,664	283,704	181,291	269,257	.....	17,149,541	15,800,996	1,348,545
National	2,735,486	63,185	12,013	81,990	.....	3,059,445	3,058,862	583
Northeast	1,140,764	9,917	10,368	23,356	39,592	1,243,459	1,043,196	200,263
Northwest	4,588,374	135,978	81,212	185,106	.....	5,065,784	4,227,943	837,841
Trans World	15,097,364	344,000	253,707	44,251	.....	16,376,804	16,256,440	120,364
United	21,652,121	705,227	406,423	1,048,783	.....	23,994,835	19,560,328	4,434,507
Western	3,180,149	79,109	35,222	48,088	.....	3,382,999	2,640,065	742,934
INTERNATIONAL								
American	463,918	13,742	314	64,404	.....	560,075	443,821	116,254
Braniff	490,655	117,634	.....	23,324	.....	665,114	520,270	144,844
Caribbean Atlantic	118,969	1,529	.....	4,007	.....	133,587	111,240	22,347
Delta	462,095	5,332	.....	10,248	.....	496,671	385,732	110,939
Eastern	1,330,632	20,051	.....	17,647	.....	1,495,346	1,184,789	310,557
National	191,190	2,030	830	5,737	.....	203,574	275,504	—71,930
Northwest	1,677,145	464,240	5,467	279,011	.....	2,535,051	2,035,634	499,417
Pan American								
Alaska	545,000	21,000	.....	90,000	111,000	811,000	751,000	60,000
Atlantic	11,540,000	776,000	.....	676,000	153,000	13,474,000	10,560,000	2,914,000
Pacific	5,314,000	627,000	.....	558,000	60,000	7,009,000	5,275,000	1,734,000
Latin America	5,961,000	260,000	.....	838,000	519,000	8,162,000	7,294,000	868,000
Panagra	1,255,668	84,108	.....	123,648	.....	1,674,289	1,611,871	62,418
Trans World	6,025,167	543,153	.....	322,083	.....	7,097,641	6,171,256	926,385
United	1,508,526	29,014	.....	13,779	.....	1,558,892	1,045,708	513,184
LOCAL SERVICE								
Allegheny	455,685	9,141	10,504	6,706	127,125	616,253	632,921	16,668
Bonanza	144,401	2,810	1,396	3,877	100,908	267,457	247,113	20,344
Central	103,944	3,177	830	3,557	172,637	289,892	284,272	5,619
Frontier	292,714	213,368	3,115	21,905	.....	536,817	519,668	17,149
Lake Central	121,662	3,293	6,762	.....	106,766	239,244	235,258	3,986
Mohawk	401,404	4,707	4,936	7,044	52,705	488,353	510,076	—21,723
North Central	645,349	18,081	10,571	.....	65,587	758,083	731,580	26,503
Ozark	296,845	193,935	7,160	7,659	.....	509,496	549,782	—40,285
Piedmont	487,021	9,483	6,221	6,907	156,319	678,609	688,530	—9,921
Southern	182,588	7,921	5,596	.....	128,658	333,529	343,818	—10,288
Southwest	306,731	9,234	3,704	3,471	105,485	459,765	451,620	8,145
Trans Texas	279,044	10,070	3,509	10,256	188,660	498,408	541,389	—42,981
West Coast	211,990	3,636	1,516	3,789	132,544	357,887	320,520	37,366
HAWAIIAN								
Hawaiian	506,049	2,923	.....	64,803	20,814	605,635	478,087	119,293
Trans Pacific*	.....	.....	.....	.....	.....	.....	.....	.....
CARGO LINES								
Aerovias Sud Americana*	.....	.....	.....	.....	.....	.....	.....	.....
Flying Tiger*	.....	.....	.....	.....	.....	.....	.....	.....
Slick*	.....	.....	.....	.....	.....	.....	.....	.....
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western	.....	.....	.....	2,034,735	.....	2,034,735	1,885,715	149,020
HELICOPTER								
New York Airways	33,179	2,534	1,606	2,807	109,623	151,718	166,996	—15,277
Los Angeles Airways	13,613	8,759	6,655	.....	60,118	89,622	98,681	—9,059
Chicago Helicopter Airways*	.....	.....	.....	.....	.....	.....	.....	.....
ALASKAN								
Alaska Airlines	195,664	49,098	1,283	87,473	91,575	603,495	515,533	87,962
Alaska Coast	88,900	8,775	7,864	.....	31,439	152,590	122,569	30,020
Cordova	20,980	19,122	11,538	.....	.....	219,028	169,429	49,598
Ellis Air Lines	57,250	5,325	.....	7,753	20,325	108,480	73,604	34,875
Northern Consolidated	121,326	31,829	414	42,458	31,801	311,490	284,991	26,498
Pacific Northern	764,810	220,527	.....	115,742	.....	1,124,773	858,685	266,088
Reeve Aleutian	79,796	19,657	.....	10,080	99	139,996	81,606	58,389
Wien Alaska	155,185	33,598	.....	30,319	43,266	636,912	606,710	30,202

*Not available

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.



De Havilland Otter, equipped with Flight Refueling hose reel unit, transfers fuel to Vertol H-21 on its record-breaking, non-stop transcontinental flight.

NOW! FLIGHT REFUELING FOR HELICOPTERS

How Probe and Drogue system, pioneered by Flight Refueling, Inc., can be successfully used for helicopter to helicopter refueling is shown in preliminary Marine Corps trials.

How to get helicopters across long stretches of water or forbidding terrain where ground facilities are non-existent has been successfully and conclusively solved by aerial refueling.

Two recent major developments have contributed to the solution of this problem.

Late this summer an Army Vertol H-21 made the first helicopter non-stop transcontinental flight in history. This flight marked the first actual aerial refueling of a helicopter.

In addition, other armed services have successfully conducted experimental refueling between rotor-winged aircraft.

It is typical that the Army's historic transcontinental flight was made possible by a refueling system developed and produced by Flight Refueling, Inc., and that a project to extend the range of Marine Corps helicopters is being undertaken by Flight Refueling, Inc. – the only company in the world devoted exclusively to the development and manufacture of aerial refueling, aircraft fuel systems and related components.

ATTENTION ENGINEERS

Helicopter refueling is only one of many fascinating projects being undertaken by Flight Refueling, Inc. Many long-range projects present unusual career opportunities for engineering personnel. Wire Bill Whitesides, Engineering Manager, for further details.

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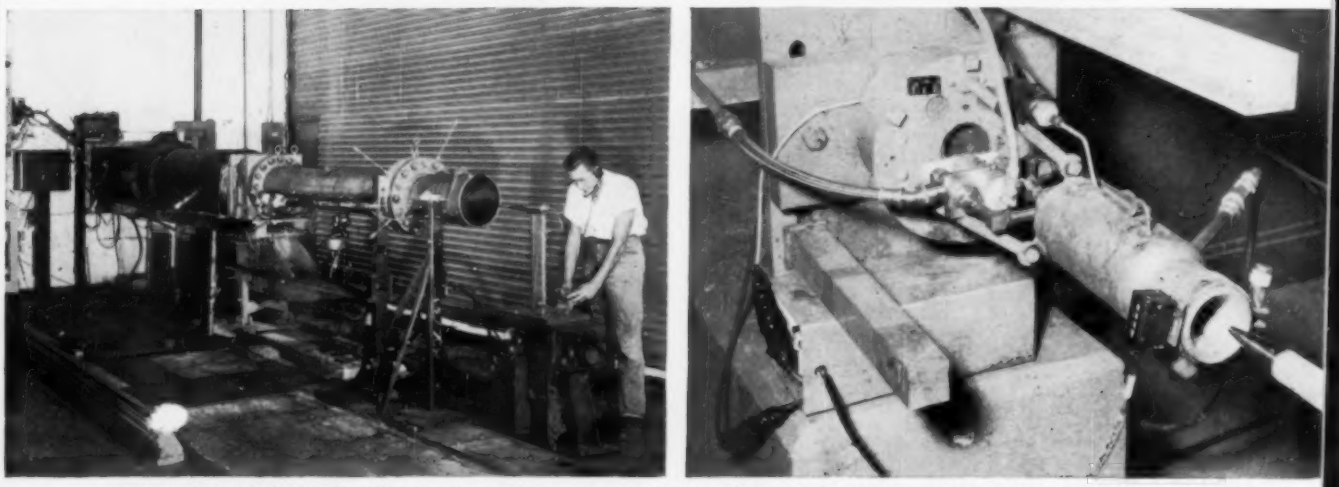
Robert L. Marquardt, 6198 Locust Hill Road, Dayton 9, Ohio



ETHYLENE JET (left) is basically a ramjet combustion system burning ethylene in high-pressure air to produce a 3,500F air blast. Rocket jet (right) subjects models to the exhaust of a liquid-propellant rocket and can produce temperatures up to 4,100F.

Heating Studies Tax Apparatus Ingenuity

Langley AFB—Laboratory simulation of aerodynamic heating calls for technical ingenuity almost comparable to that needed to create aircraft which will meet the problem in flight. NACA's Langley Aeronautical Laboratory furnishes several prime examples of the apparatus maker's skill.

Some exploratory devices used at Langley are:

• **Static model** test units such as ceramic heat exchanger tunnels, combustion products tunnels, special compressors, shock tubes, furnaces and radiators.

• **Flying models,** including gas launched projectiles, rocket-borne models and full-scale aircraft.

• **Combinations** of flying models and static test units. Projectiles or models are flown up stream into the test sections of high speed tunnels. Among these are the re-entry simulators.

As air is expanded through a supersonic nozzle into a high speed tunnel test section where it is adiabatically cooled greatly reducing the value of aerodynamic heating test runs. Steel heat exchangers have been used to raise air stream temperatures by drawing heat from external furnaces. Their value has been limited because they soon reach temperatures approaching the melting points of metals (4,000-6,000F).

NACA's ceramic heat exchanger raises air stream temperature limit to the melting point of metals used in earlier exchangers. When the idea was first conceived scientists were not certain this potential could be fully realized.

High speed air streams develop steep temperature and pressure gradients independently and it was feared these might upset test results.

Rather than risk waste of scarce funds

CAST MAGNESIUM fins for the Nike booster failed due to aerodynamic heating when surface temperature got high enough in special uses to melt the leading edge (right). Blunting the leading edge for its razor-sharp section reduced heat transfer, but not enough (center). Capping the fin with Inconel (left) solved the problem for the duration of the highspeed flight.

on a big project NACA built a small scale model of the ceramic exchanger tunnel to find out if the idea was workable.

The little tunnel can produce a three-quarter inch jet with a velocity of 5,000 fps. and a stream temperature of 4,000F. The jet nozzle is water-cooled to keep it from melting or changing shape in a way that might affect the speed, smoothness, or direction of flow.

Fears about the effect of gradients in the stream failed to materialize and the full-scale ceramic heat exchanger is now being built. Architecture of the unit is somewhat unusual because of the immense size of the heating plant relative to the test section.

Rocket Exhaust

Combustion products tunnels are essentially rockets or ramjets with the exhausts used to simulate air streams. Though the chemical composition of the combustion products differs from that of air, temperatures, pressures and velocities can be controlled to provide a good simulation in other respects. It is possible to get some measure of oxidization effects on the model by using a mixture of fuel and oxidizer which will leave some free oxygen in the stream.

One advantage of the combustion products tunnel is that heat is produced so quickly by the release of chemical energy that hot gases need not be controlled over a very great distance. The result is simplicity and smaller unit size.

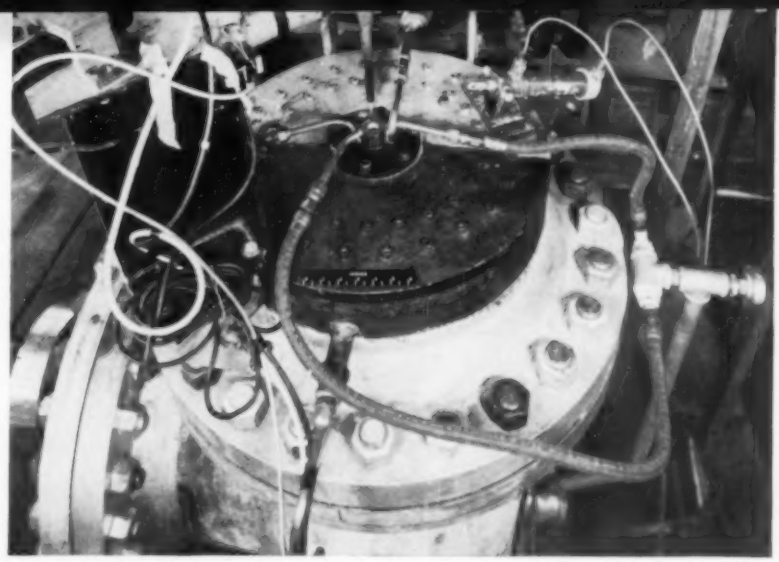
One of the combustion products tunnels is the rocket jet. It is a liquid propellant rocket motor with a 2½-in. nozzle.

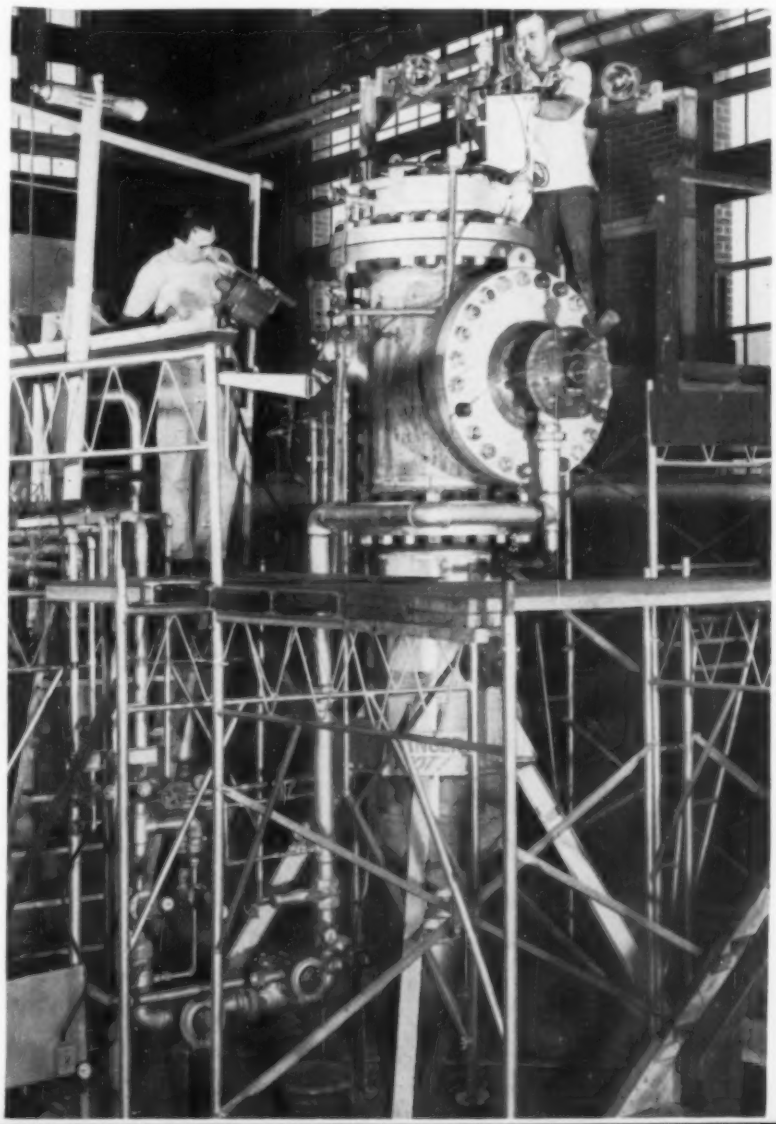
Models used in the test section may be up to one inch in diameter. Maximum stream velocity is about 7,000 fps. and stagnation temperatures up to 4,100F can be produced. Exhaust products are oxygen, nitrogen and water vapor, the major constituents of air. The proportions, of course, differ.

One of the uses of the rocket jet is materials testing. In a demonstration the stagnation temperature on a titanium nose cone was raised to 3,000F. In actual flight a speed of Mach 7 at altitude would produce the same temperature. The cone burst into flames and was destroyed in the demonstration because of the increased affinity of titanium at high temperatures for nitrogen and oxygen.

Large Nozzle

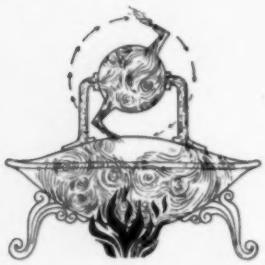
The ethylene jet at NACA's Wallops Island station has a 12-in. nozzle permitting researchers to use relatively big models. Hot, high pressure air is fed to the unit from the nearby preflight jet facility. The burning of



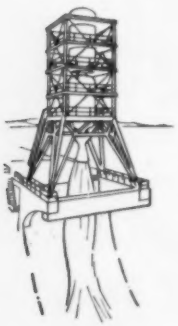


CERAMIC heat exchanger is prototype for larger unit to produce highspeed, high temperature jets of air. Tiny orifice (top) has conical probe under test in blast through a water-cooled nozzle ¾-in. in diameter. Complete unit (bottom) gives impression of size and complexity of apparatus needed to produce only a small test jet. Unit is lined with ceramic "marbles" to contain extreme temperatures needed, which exceed the melting point of most metals.

ROCKET POWER



Only yesterday they called it "the art of rocketry." Today, in the first rank of aeronautical science, rocket propulsion is an engineering discipline, an applied technology, and an established industry. The applications for propulsion devices are manifold, the potentialities unbounded.



Aerojet-General Corporation needs men of perspective, inspiration, and practical imagination...To these Aerojet offers unbounded opportunity.

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SACRAMENTO, CALIFORNIA

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ethylene in a combustion chamber then raises air stream temperature yet higher. It is capable of creating stagnation temperatures of about 3,500F and stream speeds of 4,300 fps.

Flying models can provide the closest simulation of the real thing but they are expensive and hard to observe. Because of this, flight tests are closely coordinated with tunnel tests.

An example of this occurred when a hypersonic test rocket was fired from Wallops Island to check aerodynamic heating on a specimen nose cone. The first stage was an Honest John motor and the second stage was a Nike booster. The second stage should have reached a speed of Mach 5 but two seconds after it was ignited it yawed away from its course and crashed indicating the failure of a stabilizing fin. Estimated speed at the moment of the yaw was about Mach 4. From this it was possible to conclude that aerodynamic heating might have raised the temperature of the magnesium fin to its melting point.

To establish this and find a successful configuration three specimen fins were tested in the ethylene jet. The maximum stream temperature was 1,900F and the elapsed time of each run was 2.3 sec. It was estimated that this would approximate the heat input of the test rocket flight. The first fin was identical to the one which failed, a good supersonic design with a knife-like leading edge. A large part of it was burned away indicating that the cause of the crash had been correctly identified.

The second fin, also of magnesium, was redesigned with the leading edge blunted to a $\frac{1}{8}$ in. radius to provide better heat transfer. Less of it burned, but too much to be acceptable. The third fin was identical in design to the second but the leading edge was capped with a $\frac{1}{32}$ in. sheet of inconel. This one suffered no damage and was adopted for further flight tests. Coordinated testing such as this has raised the speed limit on NACA flight testing beyond Mach 10.

Turbocraft Organized for Missile Projects

Pasadena, Calif.—Turbocraft Inc. has been organized to provide design, development and consulting services in the field of aircraft and missile rotating machinery, specializing in accessory-drive turbines and turbopumps.

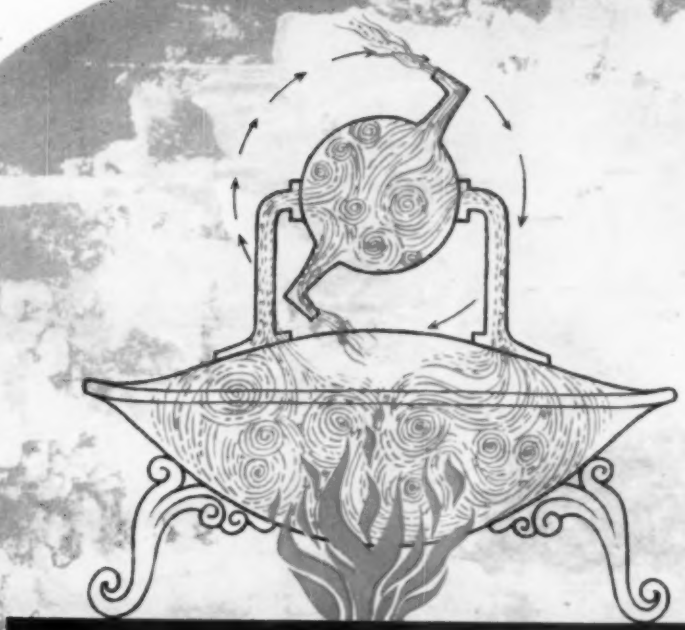
Key engineering personnel are five long-time employes of Aerojet-General Corp. who have resigned from Aerojet to form their own company. They are: Thomas A. Carter, Jr., who is vice president and chief engineer of Turbocraft, Robert D. Lutjens, John S. Bass, Paul P. Duron, and Alvin Hooper.

All were employed in Aerojet's Rotating Machinery Dept. Carter was assistant chief of the department. Lutjens was supervisor of Test Section; Bass, staff assistant to the department's chief engineer; Duron, supervisor of Design Section; Hooper, supervisor of Turbine Section.

President and general manager of Turbocraft is Doyle Lindley, formerly marketing manager of Western Gear Corp.'s Electro Products Division, Pasadena.

Japanese Rocket

Japanese Kappa 128 JS experimental rocket being prepared for firing at Tokyo University's rocket proving center at Michikawa Beach. Rocket, capable of 2,700 fps., travels 24,000 ft. during 72 sec. flying time, will be used during Japanese participation in International Geophysical Year.



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Cornell Instruments for Shock Tubes

By Robert Cushman

Buffalo, N. Y.—Working models of all basic temperature, force, pressure and flow visualization instruments that hypersonic aerodynamicists need to get useful information out of shock tube test runs of millisecond duration have been developed at Cornell Aeronautical Laboratory.

The Cornell Laboratory, which has been a leader in the development of hypersonic shock tubes, has been hard pressed to find instrumentation which has the necessary speed of response. Now the same caliber of information can be obtained from shock tubes that has been available from wind tunnels.

Heat Transfer

Typical of these instruments is a tiny probe which, when mounted flush on the skin of aerodynamic shapes, will sense the heat transfer rate during the passage of shock. Cornell combined and extended known principles to produce the probe, which consists of four millionths of an inch of platinum film baked onto a glass base.

Depending on the limitations of the bonding agent, this thermometer can withstand 1,000F steady state or greater temperatures for the duration of the shock tube test time interval. Its time constant is 6 x 10^{-6} seconds and its nominal sensitivity is 10 millivolts per degree F. It can keep up with temperature rises of 1,000F in less than one millisecond or fluctuations of 1F in 100 microseconds.

"This instrument will find applications in other fields, but the fact that it is intended to sense heat transfer rates rather than free stream temperatures perhaps limits its range of applications" Project Leader Robert J. Vidal said. It has been used by the University of Florida in a series of 35 test flights to determine the effect of the exhaust of air launched rockets upon adjacent jet engine inlets.

Fast Response

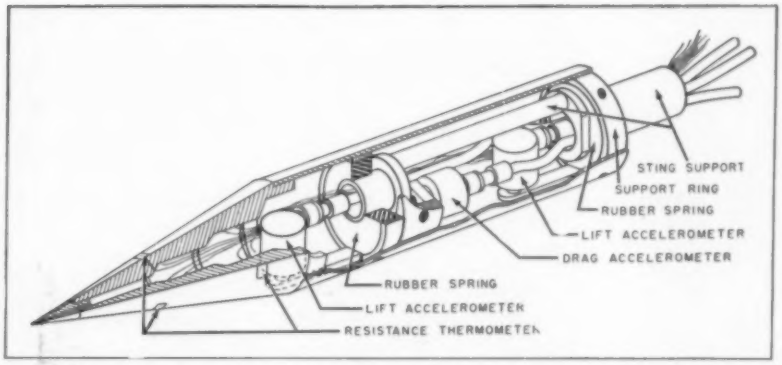
However, this possible limitation in some instances could enhance rather than detract from the thermometer's usefulness. Because it has such a fast response it could be used to make direct surveys of rocket and jet engine hot-end flows by rapidly traversing the hot flow, gathering the data and getting out before being destroyed by the extreme heat. The stream temperatures could be figured back from the heat transfer rates.

Vidal used commercially available printed circuit paint (Hanovia Liquid Bright Platinum #05-X made by Hanovia Chemical and Manufacturing Co., East Newark, N. J.) applied to either fused quartz or Pyrex glass and fired the unit to obtain a uniform film about 4 x 10^{-6} thick. The 1,250F maximum firing temperature is just enough to soften the glass so that the bonding oxide flux in the platinum paint mixture chemically unites with the glass base.

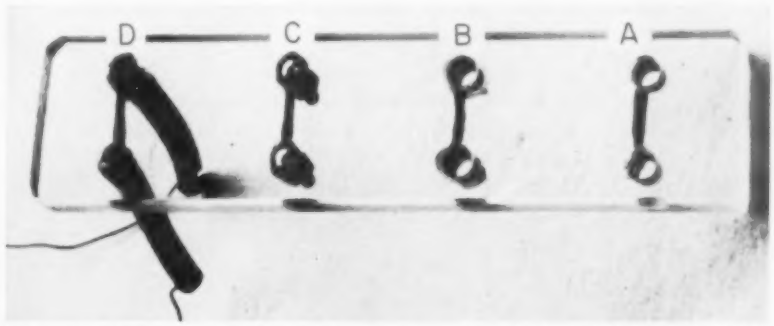
After the unit has cooled the lead wires are attached by soldering or with jewelers screws covered with silver printed circuit paint.

The thermometers are calibrated by putting them at the stagnation point of spherical models and running these models in the shock tube at subsonic flow speeds where the heat transfer conditions are well known.

Cornell believes that because of the thermometer's rapid response (quite phenomenal when compared to most temperature sensing instruments), excellent sensitivity and ruggedness that it will find many other uses. One use



SHOCK TUBE MODELS must not only squeeze many instruments in a small space, but these instruments must be capable of following wide variations in temperature, pressure and force within two milliseconds more or less steady state blast passage. This is a cut-away view of Cornell Aeronautical Laboratory's one inch diameter cone-cylinder model. New temperature probes are shown near the nose.



ABCs of putting a Cornell resistance thermometer on its glass base: (A) metal is painted between drilled holes and oven cured; (B) silver paint is put in holes and fired; (C) jeweler's screws are worked into holes and a bead of solder placed on top; and finally (D) the leads are added and the surface is ground flush.

CORNELL'S skin temperature sensors are shown mounted on a typical hypersonic test model nose. They are able to keep up with the rapid skin temperature rise (1,000F in two milliseconds) as the shock passes.

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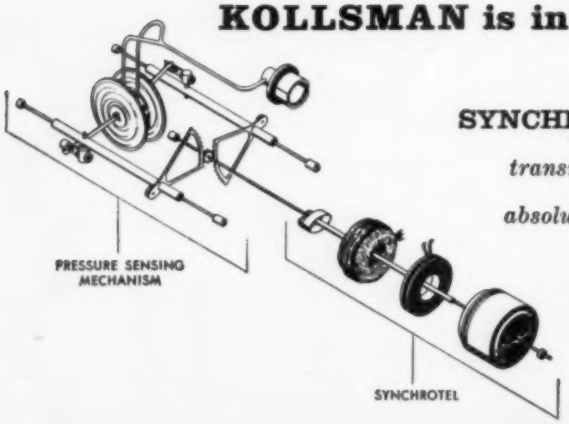

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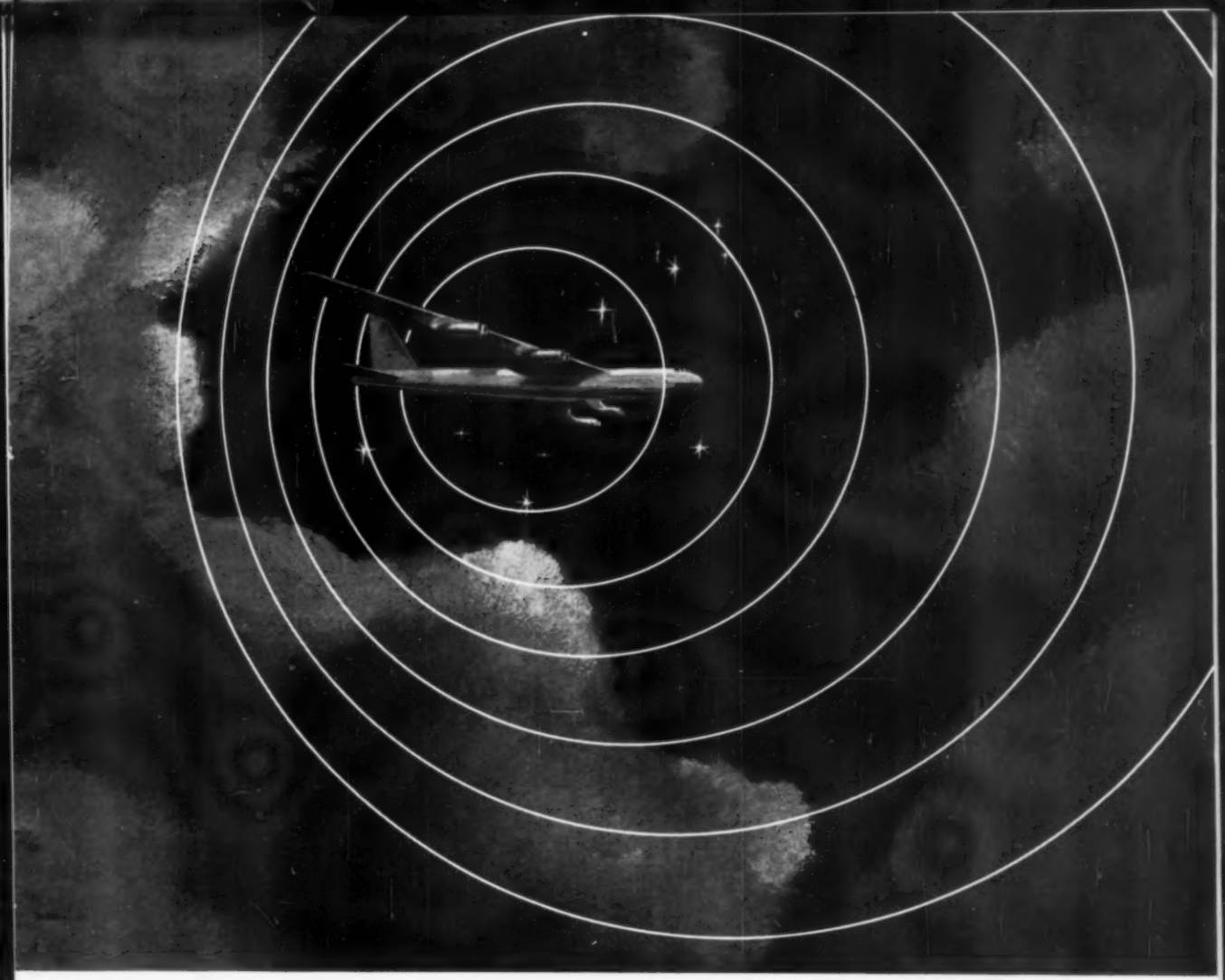

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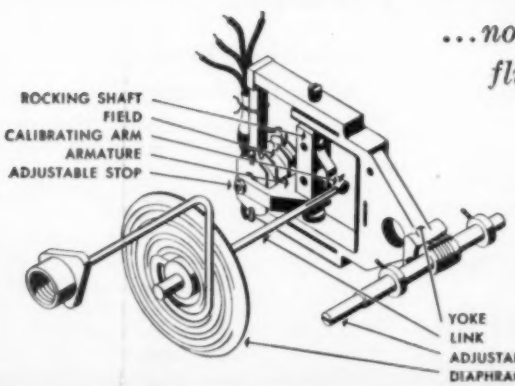

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which suggests itself is as the sensing element in engine and missile controls. Control engineers in these fields have been continually plagued by sluggish temperature sensors which bog down the performance of the whole system.

High Speed Sensors

For their high speed pressure sensors Cornell has been using miniature quartz SLM gages made in Switzerland and distributed in this country by the Kistler Instrument Co., North Tonawanda, N. Y. The signal to noise ratio has been a problem, but for lack of a better gage type Cornell has been endeavoring to learn how to live with this device.

The force system is built around small accelerometers which record the motion of the model as it vibrates on its sponge rubber mounts.

Cornell uses high speed Fastex motion picture cameras with continuous light sources and high voltage sparks to illuminate stationary photographic plates—both systems "visualizing" the flow through the Schlieren technique with variously oriented knife edges.

Lockheed Lets Contract For Nuclear Laboratory

Marietta, Ga.—Lockheed Aircraft Corp. has contracted for the construction of a $1.1 million laboratory at USAF's nuclear aircraft research facility under development on a 10,000 acre tract southwest of Dawsonville, Ga. Successful bidder was Southeastern Construction Co., of Atlanta.

The laboratory will accommodate 200-300 nuclear scientists and engineers.

Lockheed is building the facility and will operate it upon completion for USAF. Previous contracts totalling $1.2 million provide for roads and other support facilities.

Anaconda Produces Alumina From Clay

The Anaconda Copper Co. plans construction of a $1 million pilot plant for the extraction of alumina—the raw material for aluminum manufacture—from Idaho clays.

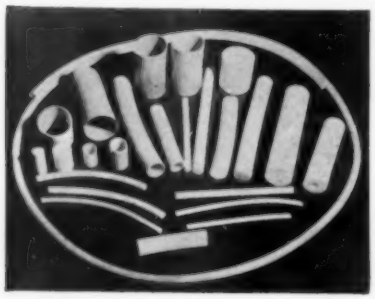
The company recently announced that test plant experiments with the process have been successful in producing commercial-grade alumina. At present, the U. S. is dependent on bauxite, largely imported from the Caribbean area, as a source for alumina.

The pilot plant will have a capacity of 50 tons per day, and require a year to construct. Anaconda has optioned vast reserves of the clay, located in the Moscow, Idaho, area, and expects to build a full-scale plant there.

Teflon Has Possible Uses for Missiles

Teflon (tetrafluoroethylene resin) pipes and pipe linings having possible missile applications are inert to nearly all chemicals and have no known solvent.

They are attacked only by molten alkali metals and fluorine at high temperatures and pressures. Teflon resists



nitric, hydrochloric, sulphuric, hydrofluoric and hydrobromic acids.

It is unaffected by highly oxidizing compounds such as aqua regia and sulphur or chlorine dioxides and will withstand 150 psi at temperatures ranging from below −90F to 500F. It has high dielectric strength and low power factor and dielectric constant at a wide range of temperatures and frequencies.

Haveg Industries, Inc., 900 Greenbank Rd., Wilmington 8, Del., manufactures the pipes and linings, which are shown in photo.

Bright Metals Can Insulate Ceramics

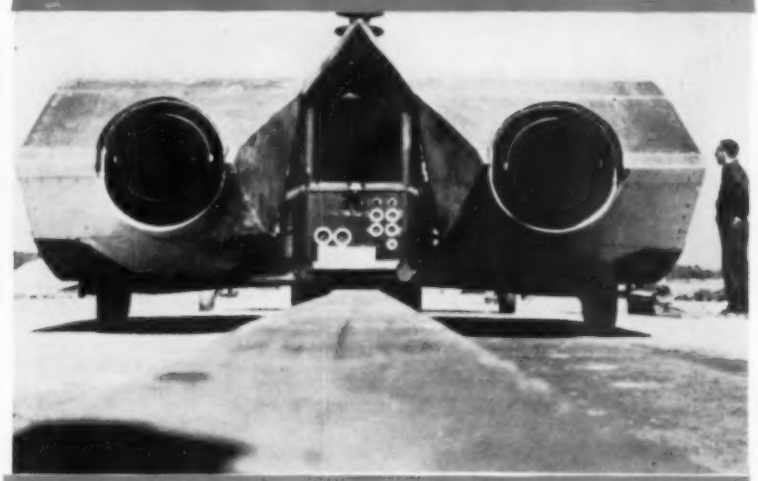
Protection of low temperature metals for hot ends of engines can be gained by use of a thin film of a bright metal such as gold or platinum over the first coating of porcelain enamel ceramic.

These non-tarnishing metals will reflect most of the infra-red energy radiated at them by the glowing gases and so help to prevent the ceramic from suffering extremes of thermal shock. The ceramics by themselves invite infra-red absorption since they are not only rough surfaced but usually dark-colored.

Platinum over a ceramic coating, for example, would enable a relatively low-temperature metal part to exist in an 1800F tailpipe gas stream. The expense might not be as prohibitive as one would expect. In films of the thickness considered (5 millionths of an inch) it only takes $17 worth of gold to cover 50 sq. ft., according to Robert Langley, Hanovia Ceramic Dept., East Newark, N. J.

proving ground for ideas needs

Creative Engineers



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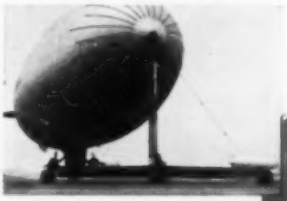

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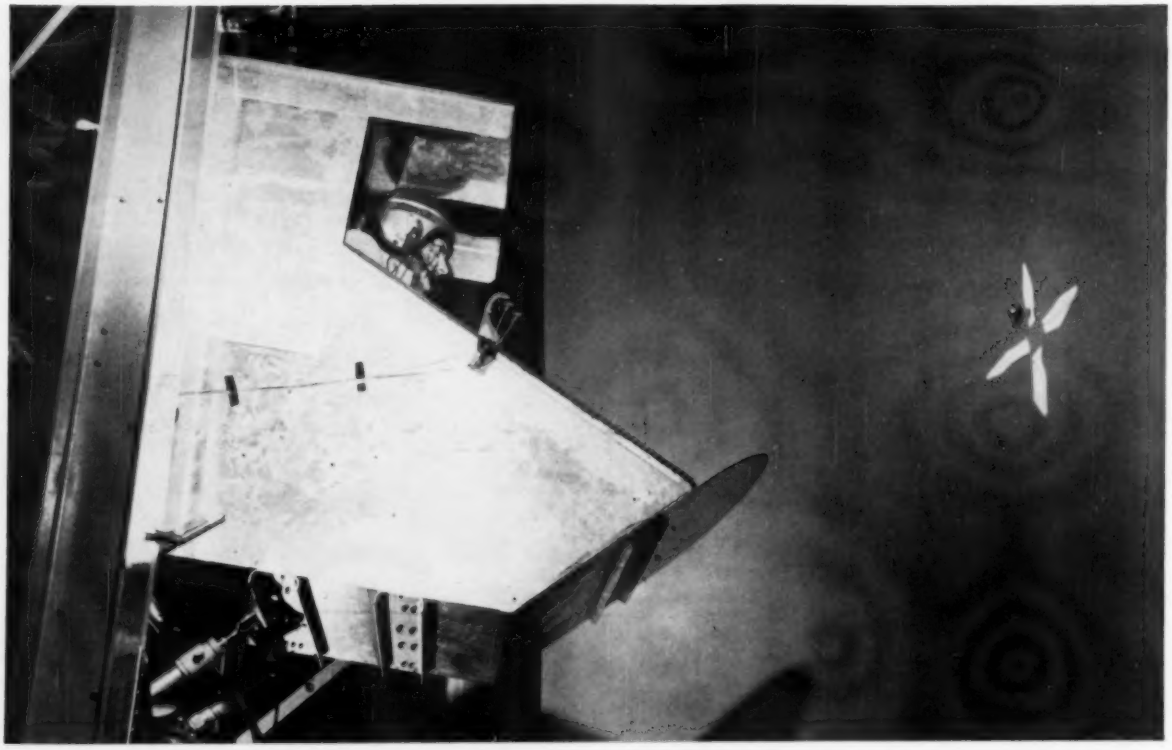

PILOT in simulator attempts to keep slide projector mounted on chair aligned with red ball at right.

High Speed, Altitude to Alter Pilot Rules

By Russell Hawkes

Langley AFB, Va.—Pilot techniques will be changed markedly as speeds pass Mach 3 and as manned flight outside the earth's atmosphere becomes a predictable thing. Researchers must forecast problems the pilot will face and seek solutions.

NACA scientists here have built simulators to expose the pilot to anticipated control problems in the relative safety of the laboratory. One is capable of simulating the longitudinal stability and control problems encountered in any type of aircraft from World War II fighters to manned ballistic missiles and space craft. It is even capable of subjecting the pilot to some of the G loads encountered in stabilizing oscillations caused by attitude disturbances.

Long Oscillations

In simulation of flight at the upper edge of the atmosphere the pilot finds that the period of oscillations caused by attitude changes is much longer than those at lower altitudes. Damping effect is small because of low dynamic forces on the airplane surfaces. For the same reason effectiveness of control surfaces is slight and correction of a disturbance must be early, large and quickly reversed to avoid long swings to the opposite side of the desired attitude. Because amount of divergence and recovery time are likely to be large, it is difficult to tell when proper correction has been applied.

NACA pilots feel that greater control force, possibly provided by jet reaction, would ease the problem considerably. However, committee's scientists are not all convinced of this.

Space Control

In space, of course, there is no aerodynamic force and no damping of oscillations. Once established they go on indefinitely without some type of positive correction as could be applied by reaction controls.

Attitude oscillations at extreme altitudes can be prevented to some extent by delicate control handling and the realization that fast corrections are impossible. In this way it is possible to avoid rotary inertias which are great enough to overcome dynamic stability and available control forces. However, this delicate handling is a full-time job and the pilot's attention is usually required elsewhere.

Command control systems are being studied by NACA as an answer to this problem. Most favored by NACA pilots is a system based on a rate gyro. Rate of attitude change produced by the system is proportionate to control stick displacement, and the system determines how much control surface movement is needed to hold the desired rate. It could also limit rate to keep rotary inertias within controllable limits.

A big advantage of such a system is that it automatically adjusts to cope with the rapidly changing control effectiveness and aerodynamic damping that might occur in re-entry to the atmosphere.

The command control system can also be designed to handle the more complex phenomenon of roll coupling, which actually consists of two types, one caused by inertia forces and the other by aerodynamic forces.

Airplane as Rotor

Inertia roll coupling is gyroscopic precession in which the airplane is the rotor.

Rotation in any direction tends to be translated into the plane parallel to the axis of inertia, the line about

which the weight of the aircraft is centered. Therefore, as the aircraft rolls, it yaws.

As the aircraft approaches a stable flat spin, force of the precession increases.

For this reason, inertia roll coupling is more difficult to control at high angles of attack. Orientation of the aircraft is closer to the plane of stable rotation at the outset.

Shorter wings and the concentration of weight in the fuselage of high speed, high altitude aircraft result in a lower rolling moment of inertia and higher pitching and yawing moments than those of past aircraft. This increases the threat of the inertia coupling.

Aerodynamic roll coupling results from high rate of roll. The helical path of the vertical fin in a fast roll can become angled away from the line of flight sharply enough to create side loads which produce a yaw.

With the command control system the pilot no longer controls surface deflection directly. This being the case, he no longer needs the leverage supplied by a long floor-mounted stick. NACA pilots have been using a four-inch, armrest-mounted stick and favor it over the long stick. They report that best control is obtained by holding it like a fountain pen because the fingers have freer and finer movement than the arm and wrist. It has been suggested that better control might be possible with the stick suspended from above where its pivot would be closer to the wrist and finger joints.

Slower Responses

Flying a supersonic problem in the stability and control simulators shows that control pressures are heavier and responses are slower than in subsonic flight.

Sudden control pressures cause violent high frequency oscillation because they disturb attitude without allowing time for the flight path to change. There is little damping at these speeds and it is impossible for the pilot to correct because the period of the stabilizing oscillation is shorter than his minimum reaction time. His corrective actions may actually come into phase with the oscillation causing it to diverge.

If the pilot takes his hands off the controls the bouncing will gradually be damped. In operational flying, however, it is not always possible to leave the airplane to its own devices.

In gunnery, weapons must be brought to bear on the enemy. In a turn, buffeting makes this difficult. Pilot induced oscillations make it nearly impossible. Considering the fact that the pilot must concentrate on an external problem rather than the fine control handling which can avert dis-

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56-29

turbances, it is apparent that the number of hits will be reduced.

Stability augmentation systems have been developed with good sensitivity and short enough reaction time to cope with the short period oscillations. One is used by NACA in conjunction with its command control system.

The stability and control simulator at Langley consists of a cockpit section mounted on a high speed elevator in a two-story, half-cylindrical shaft. The cockpit is set on trunnions so that its pitch angle can be controlled by the pilot. A nose-down angle causes the cockpit to descend. A nose-up angle causes it to rise. The half-cylindrical shaft is a light blue screen on which a cross-hair is projected from the cockpit section. A red ball on a wire provides a target which can be raised or lowered by the operator on the floor or programmed to give a varying rate of relative altitude change similar to the apparent variation caused in a gunnery run by closure with the target.

When initiating a new pilot, standard practice is to start with simulation of a World War II fighter, advance to a high supersonic type at an altitude of perhaps 50,000 ft. and then to a rocket in the outer edges of the atmosphere. Crashing against the elevator stops is the penalty for failure.

As yet the programmer has not been set up and the cross-hair and target analogy to a gunnery problem is misleading. With a constant and immediately visible change in relative altitude, the problem is essentially that of flying formation without visual reference to anything but the lead plane. A change in attitude produces the same visual effect as a change in relative altitude.

Jet reaction control is an apparent simple solution to the problem of control outside the atmosphere, but it has problems. One is how best to modulate the thrust of the jet units. NACA has built another ingenious simulator to provide a first-hand taste. They call it "the iron cross," which is what it is —two I-beams crossed and balanced upon a fulcrum. The pilot's seat is on one beam-end and pressure jet nozzles are located on the other three. Control power is supplied by compressed nitrogen. The iron cross can be controlled about all three axes.

Red Life Jackets For Crews Are Shown

Brilliant red life jackets for the exclusive use of crew members of overwater passenger flights were demonstrated by Air Cruisers Division of The Garrett Corporation. Purpose is to distinguish crew from passengers, allowing the former greater effectiveness in helping passengers through safe ditching procedures and into life rafts. The distinctive life vests will also help crewmen to distribute themselves equitably among the life rafts. Success of the jacket identification coloring has led to plans for providing all future Air Cruisers life rafts with easily identified colored striping at boarding stations.

Doman ASW Helicopter Model

Model of Doman-Fleet antisubmarine helicopter designed for Royal Canadian Navy competition was displayed publicly for first time at recent show sponsored by New England Region of the American Helicopter Society at Danbury, Conn. Three General Electric T58 turbine engines are to be nested on top of fuselage behind the cockpit. Tail hinges over top of the fuselage, and the main rotor blades fold to facilitate storage aboard carriers. Gross weight will be about 17,000 lb. Retractable launchers for ASW weapons are in fuselage.

Wanted:

Design and Development Engineers

MANY NEW aircraft—like the McDonnell Voodoo shown on the facing page—are equipped with Honeywell Autopilots, and other Honeywell aircraft control systems. And Honeywell's accelerated development programs call for many more such advanced systems to be produced.

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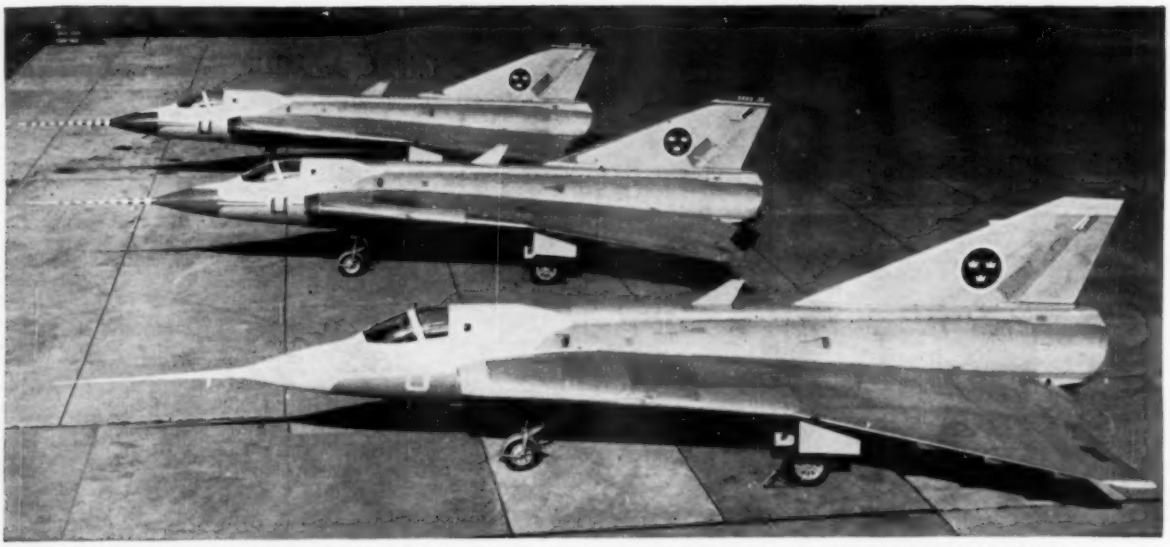
MINNEAPOLIS Honeywell

AERONAUTICAL DIVISION

McDonnell's two top "Voodoo" fighters fly with Honeywell Autopilots. The classified F-101B (sister ship to the F-101A shown) has the new Honeywell MB-5 Autopilot, which does more for the pilot than any other flight control system ever designed. A primary feature of this autopilot is a universal coupler for automatic ground control intercept, for instrument landing, and fire control. The MB-5 is another example of Honeywell Aero leadership in high performance control systems.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL



THREE DRAGONS on the ground at Saab's Linkoeping factory are prototypes for quantity production now starting in Sweden.

Swedish "Double-Delta" Design Goes Into

The Swedish air force's Dragon—a one-man, all-weather interceptor of unusual "double-delta" configuration—is in quantity production at the Saab Aircraft Co., Linkoeping, Sweden.

Gross weight of the J35 Dragon is under 20,000 lb., fully loaded and ready to fight. Powerplant is a Rolls-Royce Avon, presumably the afterburning RA 28 rated at 10,000 lb. without afterburner.

A Swedish Air Staff spokesman has said the J35 can attain speeds well above Mach 1. Wingspan of the plane is about 35 ft., and length is about 50 ft. For comparison, the wingspan of Convair's F-102A is about 38 ft., and its length is about 68 ft.

First prototype flew about one year ago, and three prototypes are now flying. A fourth airframe was built in the experimental program for static tests.

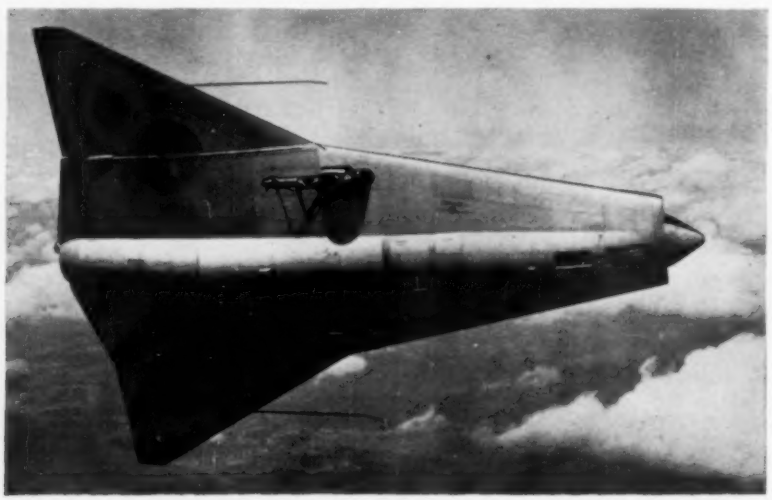
The Dragon was developed to an air force requirement outlined in 1949: "to intercept enemy bombers in the transonic speed range." Sweden's problem took on a more localized nature because of the airport situation; any interceptor would have to have high rate of climb and be able to operate out of the relatively small fields available.

Supersonic speed in level flight was another requirement and the major reason that Saab engineers under Assistant Chief Engineer Erik Bratt started with the delta layout.

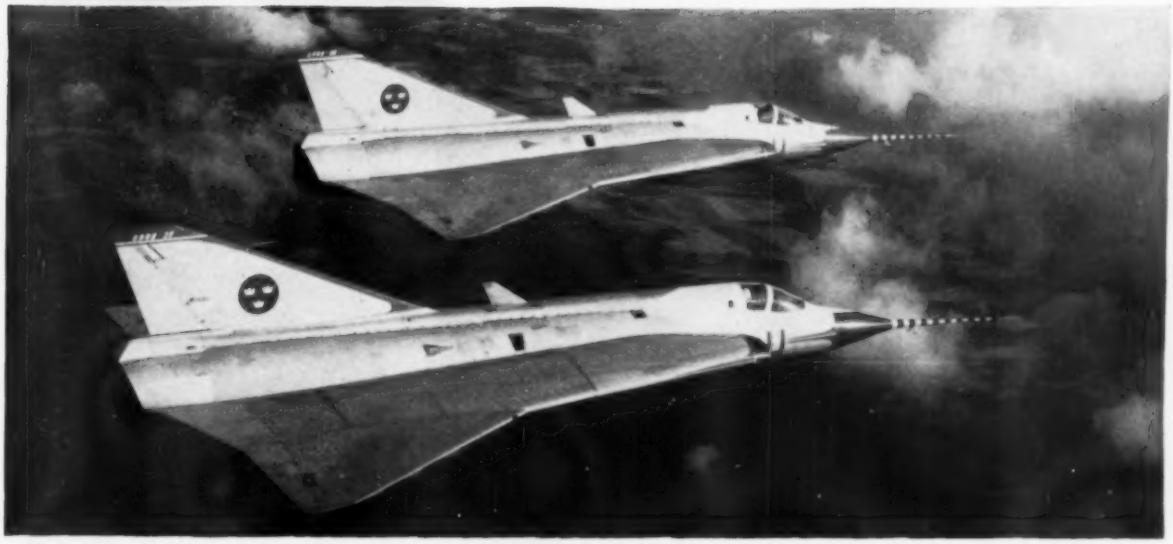
Their first approaches planned a delta wing aircraft of low aspect ratio, which would have the necessary low drag with an airframe big enough to carry the fuel and weapons load required on the mission.

But they found flaws in their design, mostly connected with the center of gravity location. To get it aerodynamically correct, they felt the fuselage had to be lengthened, and thus the airplane would be longer and heavier than necessary.

Somebody suggested the "double-delta" layout at that point, and it appeared to offer the solution. The area



SAAB 210 research plane was developed as aerodynamic test vehicle. Pilot (right) indicates size of later, longer-nosed vehicle.



FLYING DRAGONS show sleek aerodynamic layout; small separate dorsal fin on fuselage spine has been added since prototype.

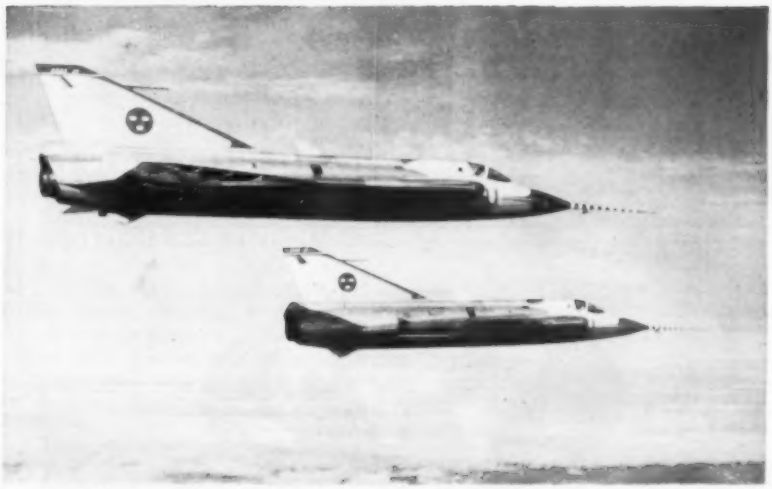
Production

distribution of the wing could be adjusted to give an optimum position of both aerodynamic center and center of gravity. It looked like the final answer.

All that remained was the proof testing.

The double-delta layout was developed in wind tunnels and with the Saab 210, a tiny research aircraft with the general aerodynamic form of the J35, then in the design stage. The 210 design began in the summer of 1950 by a team which later became the nucleus of the 500-man organization responsible for seeing through the J35.

The wind tunnel work was supplemented by control-line models, flown



WING FENCES on J35 design are a trio ahead of the aileron and on under wing surface only.

FIRST PROTOTYPE on ground shows basic simplicity of the ten-ton interceptor which will enter service during next few years.

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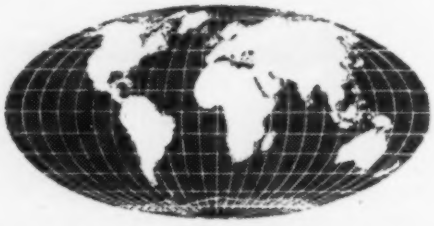

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to get a qualitative approach to some of the problems of flight. Saab's own transonic tunnel, developed at speed to back up the J35 program, began test work in the spring of 1952.

Other models of the J35 were flown into water covered with aluminum powder to study the flow behind the plane. This visual flow technique gives photographic evidence of the flow pattern in the wake.

But much more than tunnel work was required. The J35 was the first Saab supersonic design, and it meant much theoretical work.

Special courses were established in supersonic theory to give the engineers familiarity with their new task. Computers, both at Saab and the government-owned unit in Stockholm, were utilized and are still used for refinements in the analyses.

Other tests aids included a cannon to shoot birds at supersonic speed against the windshield of a mockup, special hydraulic system and fuel system test rigs, and a static test rig using more than 5,000 strain gages.

Soviets Plan 100-lb., 20-24-in. Satellite

Designs for the USSR's first artificial satellite—scheduled for launching next year—call for a hollow aluminum sphere not over 20-24 in. in diameter and weighing almost 100 lb., according to a leading Russian physicist.

Prof. Georgi Pokrovsky, writing in Moscow News, says that such a satellite must be launched on its course from a rocket at a height ranging from 185 to 810 mi. He added:

"To revolve around the earth, the artificial satellite must have an initial speed of 5 miles per second. This speed can be achieved by multi-stage rockets. According to one of the designs, the rocket will consist of three sections. The first takes the artificial satellite to an altitude of 50 mi., the second to an altitude of 200 mi., and, finally, the third gives it sufficient speed to begin circulation around the orbit of the earth.

"According to some of the calculations, this rocket must weigh almost 150 tons, which is approximately ten times greater than the largest existing rocket. Other calculations put its weight at a lower figure. It could be launched with the help of a turbojet engine mounted on an airplane.

"Enormous technical difficulties have to be overcome to create artificial satellites. For instance, to achieve the speed of 5 mps., this rocket must have a fuel tank weighing many, many times the weight of the rocket itself. In modern rockets, the weight of fuel is only 75-80% of the overall weight."

S-58 Shows its Maneuverability

Experimental Sikorsky S-58, taken off military production line for CAA certification testing, performs at a recent show sponsored by the New England Region of the American Helicopter Society at Danbury, Conn. Above, the S-58 pulls up in nose-high attitude. Pilot was Frank Yirrell of Sikorsky test staff. Army Vertol H-21 is parked on ground, and Nagler experimental co-axial testbed is in background (lower left).

Recovery completed, S-58 starts return run.

In 90-deg. bank, S-58 turns back to crowd.

Low altitude wingover is begun by S-58 (left). In near vertical nose-high attitude (center), nose starts to fall off toward the left.

HARD WORK IN ICELAND—Supporting an aerial survey team in Iceland, this Sikorsky H-19 of the U.S. Air Force carried personnel and supplies between ship and shore bases. In 23 flying hours, the helicopter carried 41 people and 47,000 pounds of cargo. This is a good example of how rugged Sikorsky helicopters can operate from very small areas, with minimum support facilities, and under a variety of weather conditions.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS

FIRST S-58 TO BELGIUM—The first units of a fleet of 12-passenger Sikorsky S-58Cs have been delivered to Sabena Belgian World Airlines. Sabena will operate the fleet on its European routes. Larger and more powerful than the S55s Sabena now flies, the S-58C, named the *Continental*, cruises at 105 miles per hour.

1000th S-55—B. L. Whelan, general manager, and Igor Sikorsky, engineering manager, mark a milestone in production of transport helicopters with completion of this 1000th Sikorsky S-55, a Marine Corps HRS. Two newer and larger helicopters are also in production, the S-58 and the twin-engined S-56.

AIRLIFT DEMONSTRATION—To show evacuation techniques in the removal and transport of light aircraft, an Army Sikorsky H-34 helicopter carries a Cessna L-19. The demonstration and the suspension arrangement were worked out at Fort Sill, Oklahoma, site of the Army's H-34 transition school. The Sikorsky H-34, the Army's newest helicopter in operational use, can carry cargo loads of up to two tons or 17 combat-ready soldiers plus crew of two.

HELICOPTER HISTORY

H-34 SPEED RECORDS

In July, 1956, an Army Sikorsky H-34, flown by Capt. Claude Hargett, right, and Capt. Ellis Hill, of Fort Rucker, Ala., established new closed-circuit speed records. The records were for 100 km, 141.9 mph; for 500 km, 136 mph; and for 1000 km, 132.6 mph. The previous 1000 km closed-circuit world speed record for rotorplanes, 66.6 mph., was set by a Sikorsky R-5A in 1946.

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Giannini-equipped North American F-100C undergoing visual check prior to take-off.

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West Coast Survey Stirs Avionic Moves

By Philip J. Klass

At least 15 Eastern and Midwestern electronic component manufacturers are expected to set up West Coast engineering-manufacturing facilities as a direct result of a recent survey which revealed that Southern California's billion-dollar-a-year electronics industry is dissatisfied over its relations with 85 Eastern-Midwestern vendors.

Failure to provide adequate engineering liaison, excessive delivery time and transportation costs were the principal criticisms leveled at "foreign" suppliers in the survey, conducted by the Los Angeles Chamber of Commerce. Los Angeles area equipment makers buy more than 50% of their components from outside the Southern California area.

Research Ideas

The survey also pinpoints the type of components that need more research and development effort, in the opinion of Southern California equipment manufacturers. The survey results are based on returns from 146 companies, representing 29% of those in the area and whose gross sales represent more than 50% of the area total.

The survey results constitute both a warning and notice of opportunity for component manufacturers. For example, it:

- **Disclosed that 85 Eastern-Midwestern** firms could improve their sales and service to the local industry by locating an engineering-manufacturing facility in the Southern California area. (The survey report does not list the companies, but Los Angeles area industry teams are visiting each of 85 to discuss the survey results. Visits to date have led 15 firms to commit themselves to set up West Coast operations.)
- **Urges better engineering liaison** by using field/sales engineers instead of non-technical salesmen.
- **Reports that off-the-shelf** components generally fail to meet the quality and environmental standards needed for advanced military systems.

Behind The Survey

The recent Chamber of Commerce survey was a follow-up to a previous one made in 1954, resulting from a critical component shortage that had developed in the area. At that time, Los Angeles area industry felt that it was being seriously handicapped by higher costs resulting from excessive inventories which had to be maintained to compensate for transportation delays, and because of inadequate vendor engineering liaison. The 1954 survey was made with the view to exposing critical areas and encouraging local industry to fill the voids where possible.

This spring the Chamber decided to re-survey the situation. It formed an Electronic Component Development Committee with key industry representatives, headed by Gen. Harold L. George (USAF Ret.), former general manager of Hughes Aircraft Co.

Excessive Delivery Time

In its survey, Los Angeles area equipment manufacturers were asked for details on their "critical" components—those posing quality, price, and/or delivery problems. A breakdown shows that approximately 90% of the critical items listed is imported from Eastern-Midwestern vendors; the balance is bought locally.

When asked the following questions on each of 34 different types of critical components or raw materials the response was as shown:

- **Is delivery time excessive?:** 389 "Yes," 30 "No."
- **Are transportation costs excessive?:** 121 "Yes," 242 "No."
- **Is engineering liaison inadequate?:** 167 "Yes," 209 "No."

A breakdown of the distribution channels employed indicates that approximately 78% of the critical components are purchased through manufacturers representatives, 10% are bought direct from the manufacturer, another 10% through jobbers, and the remaining 2% through wholesalers.

Price Differential

The survey asked Los Angeles equipment makers whether any components purchased from Eastern and Midwestern manufacturers were priced lower than comparable components made locally, despite possible transportation costs.

To this question, 55% replied "yes," 35% replied "no" and 10% declined comment.

The survey asked which "imported" components had the price edge and the approximate price differential. The greatest price differential existed for a.c. solenoids (100-200%), brass tubing (100%), RF coils (50-75%) and selenium rectifiers (60%).

When asked whether closer engineering and design liaison between component and equipment manufacturer was becoming more important, 94% answered in the affirmative.

Non-standard components are fast becoming the rule rather than the exception, as the result of demanding environmental requirements for new weapon systems, the survey report indicates.

A number of those surveyed expressed the view that component makers are not keeping abreast of equipment requirement needs and are failing to anticipate future requirements.

However, a significant number of respondents indicated that the equipment manufacturer's engineers must work more closely with component makers to give them as much technical data as is available on their program requirements, and must take the initiative to notify the component maker when new problems or requirements arise in their programs.

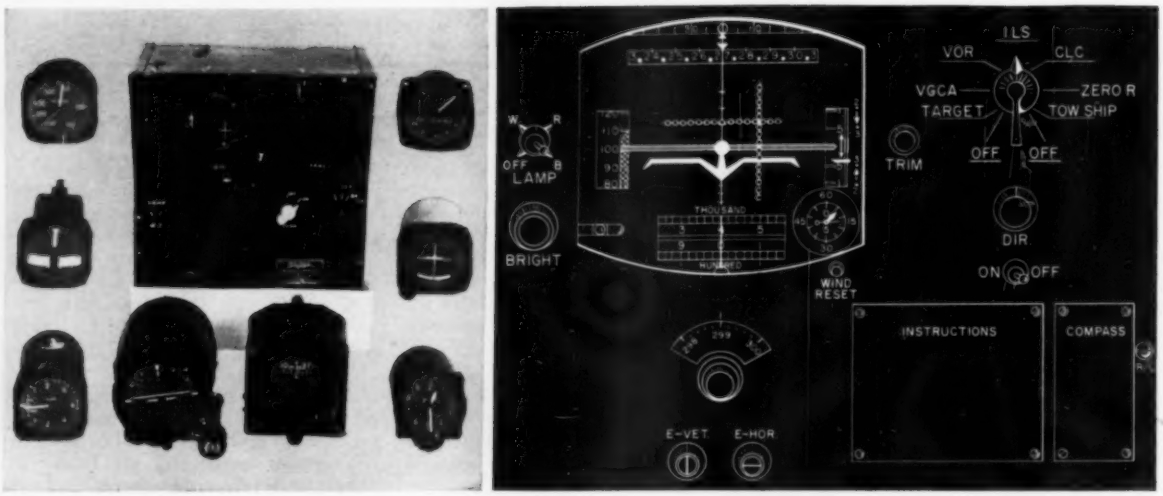
The survey report notes that "engineering liaison between the Eastern vendor and the local manufacturer is a major problem. Many Eastern firms have helped this situation by establishing an engineering facility in the area or by working very closely with local representatives. Local warehousing of components by Eastern vendors who have engaged the services of a local firm for possible re-design and engineering on a contract basis seems to be increasing in popularity."

Where R & D Is Needed

When asked which components are most in need of R & D effort to meet environmental requirements, the survey replies indicated the following, in order of frequency listed:

- **Relays**—subminiature, thermal time delay, stepping sequence, telephone.
- **Silicon transistors.**
- **Germanium diodes** suitable for high ambient temperature use.
- **Switches** — micro-miniature, rotary, solenoid, stepping, snap action, limit.
- **Transformers** — miniature precision type.
- **Vacuum tubes** — subminiature shock resistant, high plate dissipation types.
- **Servo motors.**
- **High temperature wire.**
- **Photo cells.**
- **Electrolytic capacitors.**

Copies of the survey report on electronic components can be obtained by writing to the Industrial Dept., Chamber of Commerce, 404 South Bixel St., Los Angeles 54, Calif.



CRANE Alweather Flitegage, tested in 1951, combines roles of many instruments (shown around experimental unit, left) in single display.

Early Forerunners of New USAF Instrument Display Disclosed

Following publication of the first of two articles on the USAF's new integrated panel instrument program (AW July 23, p. 62), AVIATION WEEK received several letters from readers pointing out that portions of the new USAF panel showed a marked resemblance to the Alweather Flitegage, designed and patented in 1950 by Col. Carl J. Crane (Ret.) Crane is a former director of the Wright Air Development Center's old Instrument and Navigation Laboratory.

Crane's comments, solicited by AVIATION WEEK, follow:

"Through the years there have been many attempts and efforts to closely associate instrument indications for the purpose of space saving. In the late twenties, as a result of my association with the late Col. W. C. Ocker (the pioneer investigator of blind flight), I approached the problem from the 'human engineering' point of view. I sought the transposition of the natural instrument into the cockpit.

"The Alweather Flitegage is the only instrument (in being, or in patent literature) to my knowledge that presents in highly practical form the visual stimulus of flight about the three principal axes and merges these with electronic indications for the several purposes of landing, navigation and fire control. (See photo and sketch, above.)

"Even in the new revelation of the Air Force you will find yaw magnitude, rate and sensing not presented in the natural manner as is bank and pitch.

"The Flitegage design was conceived not as a space saver, but rather as a 'life saver.' By this I mean its concept is based fundamentally on the vital need of supplying all pilots (beginning with the primary student), professional and private, with a flight reference that inhibits vertigo, satisfies the normal conditioned human reflexes established in learning to fly, and reduces to the clear weather values the time required to respond to the visual stimuli which guide the pilot in effecting a safe and effective approach-landing.

"That my Air Force is now sponsoring a development on which I have spent 30 years of effort is most commendable. I hope all airmen will soon derive some benefit from the effort."

CARL J. CRANE
Helotes, Texas

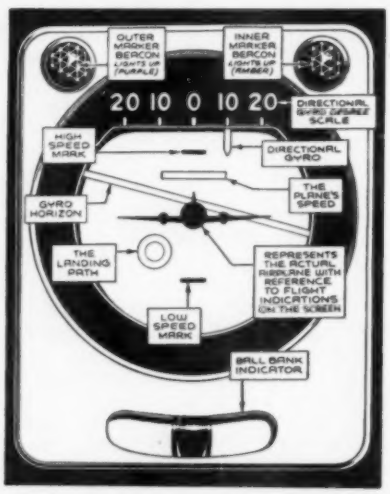
Editor's Note: The USAF's All Weather Section flight tested an experimental model of the Crane Flitegage in a B-26 in 1951. Its report on these tests, while noting certain shortcomings of the model tested, concluded:

"If an instrument incorporating the desirable features of this one and incorporating the suggested improvements, as well as meeting all the other instrument requirements, could be procured for test, it is recommended that such an instrument first undergo a complete evaluation on a simulator before installation in an aircraft."

A short series of tests conducted by the Civil Aeronautics Administration in 1951 resulted in a similar report which found merit in the Flitegage, but recommended certain design modifications.

WADC officials whom AVIATION WEEK originally interviewed for its two articles on the new instrument program made no claims that the panel layout or display techniques had originated in WADC. They freely admitted that the new instrument concepts have a long genealogy and incorporate the ideas of many people. If there is one concept which WADC might want to claim as new, although not terribly profound, it is that new instruments can be conceived and designed by a single group as a "whole panel," to preserve pilot-display integrity without disturbing the important relationship between the instrument mechanism and their respective data sources which may be undergoing developing by a variety of different WADC laboratories.

And as further proof, if needed, that many of today's newest ideas have their roots in the past, AVIATION WEEK refers the reader to the Sperry Flight-Ray, (see sketch) a multiple instrument indicator using a cathode ray tube which Sperry Gyroscope developed in 1936 and flight tested through 1943. The Flight-Ray displayed heading, attitude, airspeed, landing path, turn-and-bank, and marker beacon information.



SPERRY Flight-Ray, developed and tested in 1936, combined number of instrument functions, used cathode ray tube.

Satellite to Utilize Small, Light Inverter

Transistorized (non-rotating) inverter, capable of supplying 300 va. of three-phase 400 cps. power and which weighs only one-third as much and occupies only one-quarter as much space as a conventional rotating in-

Swedlow HEAT-REFLECTIVE PLASTICS IN NORTH AMERICAN AVIATION'S F-100

North American Aviation has effectively resolved the increasingly critical heat transfer problem by installing Swedlow's recently developed heat-reflective plastic laminate in no less than sixteen vital components in the F-100 Super-Sabre jet.

This light-weight laminate (.0625" thick, weighing .530 pounds per square foot) shows a temperature drop from 1200°F on one face to 560°F on the other face after prolonged exposure.

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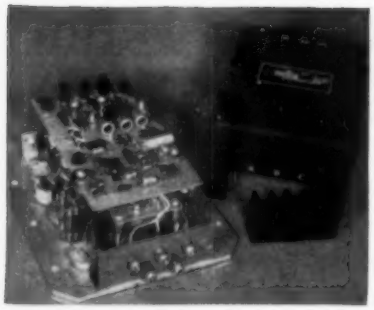


verter with similar rating, has been developed by Electrosolids Corp., North Hollywood, Calif.

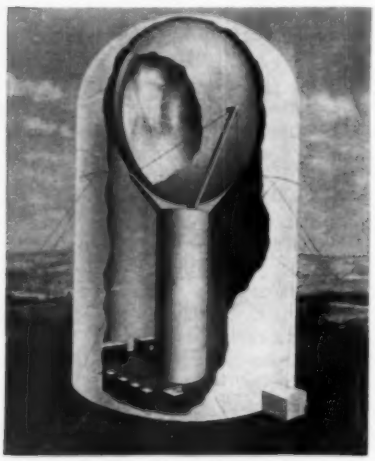
The new Model CW-1029 will be used to supply power to the servos of the second stage rocket for Project Vanguard (Earth satellite). It weighs 5½ lb., and has a volume of 96 cu. in.

The new transistorized inverter is rated at 300 va. to altitudes above 100,000 ft., and reportedly has a frequency stability of 0.2 cycles, or ½%, considerably better than conventional rotating inverters. The CW-1029 operates at 60-70% efficiency, also somewhat better than small rotating inverters. Harmonic content does not exceed 5%, according to the manufacturer.

Electrosolids says its inverter will not produce more than 0.25% voltage modulation when subjected to 10G vibrations over the range of 10 to 2,000 cycles. The device reportedly requires no servicing throughout its estimated life of more than 10,000 hr.

Electrosolids makes two types of transistorized inverters. The high frequency stability model cited above uses a temperature compensated tuning fork for its frequency reference. The other model uses a temperature compensated LC network and gives a frequency stability of 5%. Either type is available with a 400 or 5,000 cps. output.

Manufacturer's address: 7436 Varna Ave., North Hollywood, Calif.



Balloon Housing

Scatter communications antenna, using air-inflated aluminized fabric balloon enclosed in air-inflated housing, is another application for Westinghouse Electric's newly developed Paraballoon techniques (AW Oct. 22, p. 94).

Expansions, Changes In Avionics Industry

Electronic Communications, Inc., wholly owned subsidiary of Air Associates, Inc., has established new research laboratory in Baltimore. Temporary headquarters are at St. Paul St. and University Parkway, but new facilities near Johns Hopkins University are to be completed by spring.

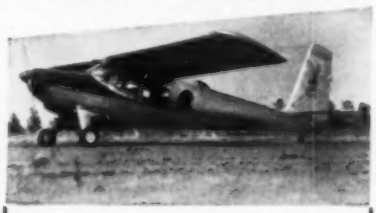
Other recently announced changes and expansions include:

• **Servomechanisms, Inc.** has opened new corporate offices at 445 Park Ave., New York City. Offices previously were located at company's Eastern Division plant at Westbury, N. Y.

• **Burndy Corporation** is new name of the former Burndy Engineering Co., Inc. of Norwalk, Conn.

• **Electro-Measurements, Inc.** has moved into new 26,000 sq. ft. plant at 7524 S. W. Macadam Ave., Portland 1, Ore.

HELIO COURIER



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Transistorized circuitry

LEAR

PIPER COMANCHE will be produced in two models, one with 180 hp. engine as in prototype, the other with 250 hp. engine.

Piper Expands Line to Meet Sales Goal

By Erwin J. Bulban

Lock Haven, Pa.—Target of $36 million in retail sales of business and utility aircraft in 1957 was put before Piper Aircraft Corp. distributors and dealers during their 16th annual meeting here last week.

Next year's sales goal does not take into account Piper's new four-place PA-24 Comanche, which the company will start delivering to distributors sometime next April, sales manager J. W. (Jake) Miller told AVIATION WEEK. He also revealed that the company is developing two basic models of the PA-24. They will be:

- **Comanche-180,** powered by a 180-hp. Continental O360, and priced at approximately $13,500. Deliveries begin next year.
- **Comanche-250** powered by a 250-hp. Lycoming O540, which will be available in 1958 with a price tag of about $16,900.

The latter model is one that Piper hasn't talked about before. The company envisages few problems in adapting the basic Comanche-180 airframe to the more powerful engine; a production Comanche-180 will be modified next year as a testbed for the 1958 airplane.

Second Prototype

The 1957 Comanche has over 100 hr. of flight test time; a second prototype has been awaiting delivery of some equipment and is scheduled to start flying this month. Some changes are noticeable on the second prototype; for example, the nose has been extended approximately four inches to allow for nosewheel travel in retraction. This was necessary when Piper switched from rubber shock absorbers to the conventional air-oil type. The revision hasn't resulted in drastic change in the airplane's balance and the longer nose probably will improve the airplane's lines. Under consideration is an electrical retraction system for the landing gear. Evaluation of equipment needed has indicated that the motor actuating an automobile seat movement could be readily adapted.

The 1957 and 1958 Comanches will be offered in three models as the rest of the Piper line is: Standard, Custom and Super Custom. The differences are in the equipment installed. The airplanes will have provision for three radios.

Piper isn't discussing detailed specifications and performance beyond saying that the Comanche will out-perform any airplane in its price class. Company officials frankly admit that the 1957 Comanche is aimed at meeting the competition it has been getting from Cessna's 180 and 182.

A well-rounded line has become a necessity in building sales volume. Piper points out, for example, that when it introduces a customer to using a Tri-Pacer for business flying, the customer may find he is extending his operations and needs higher performance. Since Piper had nothing more advanced in the single-engine class to offer him, he went to a 180 or 182. Parallel situations are experienced by most of the business and utility plane builders and have been the reason for the spurt in new designs and a wide range of types making up the manufacturers' roster in recent years.

It is too early to measure the impact of the new Comanches on the company future dollar volume, Piper says.

It is not yet taking orders from its distributors, although indications are that they have a large number of buyers committed to taking the first 180-hp. PA-24s available after demonstrators are delivered.

Standard 1957 Line

Promotion of the Comanche probably will begin before the end of this year, but with deliveries to customers some months away, Piper's distributors will be showing and selling the company's line of Apache light twins, Tri-Pacers and Super Cubs. Unit sales are expected to increase some over 1956, but not greatly.

In the sales year just past, the factory delivered 2,279 airplanes with a retail value of approximately $30 million. This was approximately $1 million over the quota set by the sales department at last year's meeting. Export sales ran about 16%, or 1% over the previous year. Spare parts valued at about $2.5 million were delivered by the factory.

The 1957 Apache is similar to the previous model with some technical improvements such as addition of a taxi light on the nose gear as standard equipment and a revision in the starter wiring system that reduces line voltage losses and improves cold-weather starts. Higher capacity carburetor heaters have been installed and carburetor air temperature gages are standard equipment. Throttle, propeller and mixture control can be positioned quickly to desired settings using graduated scales on the raceways with

numerals going from one through five.

A Piper test pilot noted that the change he liked most was revision of the engine starting system. It now consists of a handy switch located on the upper left section of the panel. Formerly two buttons were located for this purpose on the lower left side. Additional soundproofing has been added to the 1957 Apache plus a rubber-backed floor-mat to lower cabin noise levels.

Exterior Change

Most noticeable exterior change is the new standard color schemes: Daytona White cabin top to reflect sun rays and keep cabin temperatures down, black nose and engine nacelles to reduce glare, and a choice of Pasadena Rose, Cadillac Red or Key West Blue for fuselage and wings with black and white trim. Similar paint is offered for the 1957 Tri-Pacer.

About 650 Apache twins have left Lock Haven thus far. In the past year they accumulated 50 million air-miles including 24 transatlantic flights.

All 1957 Pipers show higher prices, due to increased material, labor and equipment costs, although company officials say that some of the increases have been absorbed through greater efficiencies in production.

The three 1957 Apache models carry these price tags (1956 prices in parentheses): Standard, $34,900 ($34,000); Custom, $37,780 ($36,790) and the Super Custom, $39,590 ($37,830).

The new Tri-Pacers are very similar to last year's models; most noticeable exterior change is addition of a small running board step on the right main gear to facilitate cabin access. Prices of the new models: Standard, $7,830 ($7,295); Custom, $8,430 ($7,895) and the Super Custom, $9,430 ($8,895). Approximately 4,000 Tri-Pacers are now in service, the company reports, and they are each averaging about 330 flying hours annually.

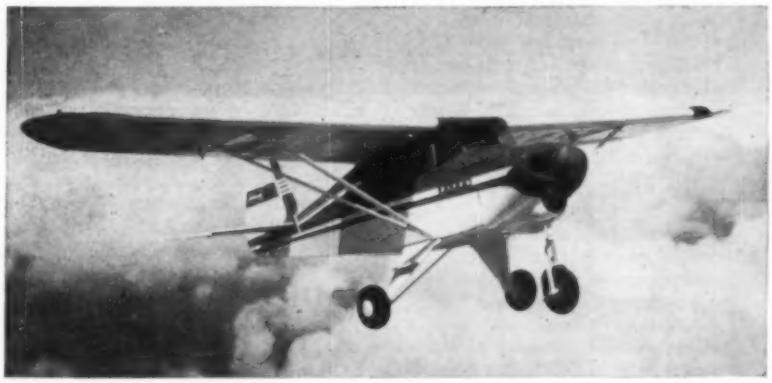
The Super Cub and PA-18-A tandem two-seaters vary little from previous models. Prices this year for the PA-18 "95" Standard, $5,295 ($4,795); De Luxe, $5,920 ($5,420). Standard PA-18 "150" will be $6,595 ($5,995); the De Luxe $7,020 ($6,320). Agricultural PA-18-A Standard model will cost $6,780 ($6,145); the De Luxe $7,205 ($6,470).

Lease Program

In response to distributor demand, Piper has developed an aircraft leasing program with International Aircraft Leasing Co., San Francisco. Standard plan covers 48 months with option to buy at the end of this period for 1% of the original price or renewing the lease. The purchaser also has the option to buy the plane any time during the course of the agreement by paying the balance of the lease less the uncarned interest on insurance plus 1% of the airplane's original value. The lease program, which covers the Apache and Tri-Pacer, has monthly payments that run consistently in size throughout the leasing period.

At its annual banquet last week, attended by 200 distributors, dealers and equipment suppliers, traditional Piper "Top Hat" awards for top sales teams went to a dozen representatives instead of the traditional 10 because of ties for fifth and tenth places. Quota busters received $15,000 in incentive awards including two-week trips to Bermuda. Top Hatters for 1956:

John Baker, Baker Aircraft Sales, Long Beach, Calif.; Art Whitaker, Portland, Ore.; George Edgcumbe, Tufts-Edgcumbe, Inc., Elmhurst, Ill.; Lloyd Brown, Brown Flying Service, San Antonio, Tex.; Joe Culler, Piedmont, Aviation, Inc., Winston-Salem, N. C.; Glenn Barr, Barr Aviation Corp., Detroit, Mich.; Howard Gregory, Des Moines Flying Service, Des Moines, Ia.; Ted Hebert, Safair Flying Service, Inc., Teterboro, N. J.; Roy Neal, Wes-Tex Aircraft, Lubbock, Tex.; Angelo DePonti, DePonti Aviation Co. Inc.,



TRI-PACER 150 for 1957 has running board step on right main gear for cabin access.

NEW COLOR scheme is used on 1957 Apache. Black nose, nacelles reduce glare.

PIPER SPRAYER is fitted with floating booms that swing back if they strike object.

ENGINEERS
Aerodynamics & Propulsion

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The Applied Physics Laboratory, (APL) of the Johns Hopkins University is an organization of and for technical men and scientists. APL is organized on a horizonal basis; responsibility and authority are given in equal measure. Scientists and technical men occupy all decision-making positions, because our only objective is technical progress.

Because of its predominantly professional character, APL has kept in the vanguard, having pioneered the proximity fuze, the first supersonic ramjet engine, the Navy's Bumblebee family of missiles which includes the TERRIER, TALOS and TARTAR, and is presently attempting break-throughs on several important fronts.

Occupying a site equidistant from Washington, D. C. and Baltimore, Maryland, APL's new laboratories allow staff members to select urban, suburban or rural living, and either of these outstanding centers of culture as a focal point for fine living. Salaries compare favorably with those of other R & D organizations.

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Minneapolis, Minn.; Harry Combs, Combs Aircraft, Inc., Denver, Colo.; Sheridan Jonas, Jonas Aircraft & Arms Co., Inc., New York, N. Y.

Quota busting teams and their sales records:

A-Team: Braden's Flying Service, Easton, Pa. (159.3%); Memphis Aero Corp., Memphis, Tenn. (157.32%); and Skyways, Inc., Vandalia, Ohio, (142.85%). B-Team: Brown Flying Service, San Antonio, Tex. (154.79%); Louisiana Aircraft, Baton Rouge, La. (144.12%); and Wallace Aircraft Co., Inc., Sarasota, Fla. (131.96%).

LeTourneau Starts Air Charter Service

A major heavy equipment manufacturer, user of executive aircraft since the 1930s, has established an air charter division for use of other corporations wishing to transport executives. LeTourneau Air Charter Service Division, with headquarters at Gregg County Airport, Longview, Tex., terminal building, is starting operations with twin-engine six-passenger Lockheed 12-A and a Beech Bonanza transferred from the L. G. LeTourneau, Inc., fleet. Another airplane is to be added later.

Assigned by LeTourneau to its new charter service are pilots Royce Barnwell and Charles N. Hammett, who have flown over 21 million passenger-miles transporting the company's personnel. W. E. Myers, head of LeTourneau plane maintenance, is manager of the new division.

Typical rates for the service will be: a party of six from Longview to Dallas in the 12-A will cost $17.50 per person, approximately seven cents a passenger-mile; rates are lower on longer flights. A two-hour layover at destination is allowed without extra charge; over this time, there will be a $5 per hour per plane standby charge.

Cooperative Program Launched To Make Private Flying Safer

New York—Four-pronged effort to improve private flying safety is being developed by Cornell-Guggenheim Aviation Safety Center here in cooperation with private and business aircraft manufacturers, pilot organizations and government agencies.

Cornell-Guggenheim began the planning as a direct result of a conference at Wichita, Kan., attended by representatives of industry and government, during which it was pointed out that the pleasure flyer averages nearly one fatal accident for every million miles flown in contrast with business flyers who average a fatal accident every 15 million miles and commercial airlines which average one every 200 million miles flown.

Critical Problems

The four most critical problems that have to be solved to make private flying safer, the conference noted, are:

- **Flight instruction.**
- **Low-level weather reporting.**
- **Safer small aircraft.**
- **Accident reporting procedures.**

Many pleasure flyers are not adequately trained to use basic flight instruments, conference members pointed out. This deficiency could be met by not only improving the flight curricula, but also by raising the quality of instruction.

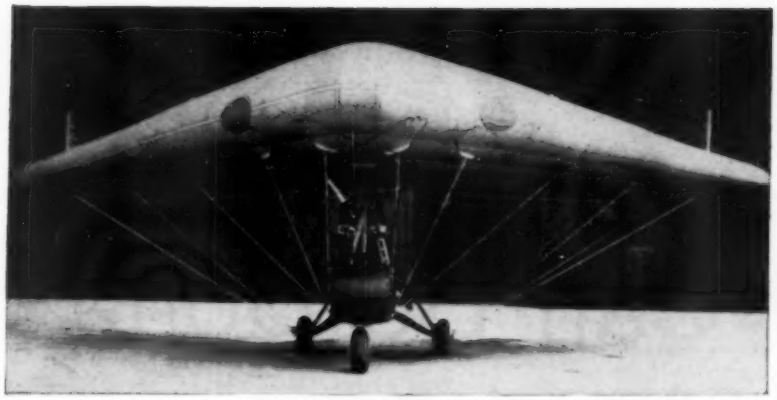
Training aids should be studied along with other new methods to see how they can be fitted into a training curriculum to bring teaching methods to the needs of modern piloting requirements. Also, conference members pointed out that increasing the instructor's income would attract larger numbers of better-qualified instructors to the profession, in turn raising pilot quality.

Civil Aeronautics Administration is studying instructor criteria to see whether any changes are necessary. It has culled records of instructors whose students have accidents and crashes early in their careers.

Limited Funds

Many private flyers do not take advantage of facilities made available to them for instrument training through their dealers, it was felt. Instrument training procedures could be overhauled and updated, based on studies by USAF and private groups—notably the University of Illinois—which have showed the benefit of instruction in Link trainers prior to going aloft.

Limited funds have handicapped U.S. Weather Bureau in adequate reporting of low-level weather, the conference noted. Commercial aircraft maintain satisfactory continuous reporting of conditions along airline routes, but private flyers have to depend on scattered reports from widely separated stations; this lack of data poses a continually hazardous situation for private pilots. Needed are additional weather observation and reporting stations and an educational program for private flyers to school them in the necessity of reporting conditions they encounter in flight. The Aviation Safety Center, National Association of State Aviation Officials and Aircraft Owners & Pilots



Inflatable Wing

Light plane with inflatable delta wing is built in England by M. L. Aviation Co. Modified symmetrical NACA airfoil is held in shape by spanwise diaphragms between upper and lower surfaces. Airborne pump and relief valves maintain the correct wing pressure. The collapsed wing can be folded and stored in the fuselage, which then may be towed by a car. Inflation takes about a half hour. Engine is a Czech Walter Mikron III providing 50 hp. and a cruise of 58 mph. Stalling speed is 30 mph. Inverted control stick is suspended from the under surface of the wing above the pilot's head.

Assn. are working on a campaign to implement this reporting program.

Rapid development of low-cost anti-spiral devices was urged by conference members since customer demands for high-performance airplanes with generally attendant high wing loadings make it difficult to design inherent spiral stability and anti-spin characteristics economically into private planes, they said. Aircraft Owners & Pilots Assn., currently is sponsoring development of an anti-spiral device, operating on pneumatic principles, that would cost $150-200 in quantity production.

Pressure Sensors

Being flight tested in a Piper Tri-Pacer, the unit basically employs flush orifices under the wing tips that lead to sensors that utilize pressure differential at the wing tips to spot a spiral. Aileron tabs are proportionally adjusted to correct the spiral.

Uniform methods of analyzing aircraft accidents are vitally needed if a dependable analysis of causes is to be made, the conference noted. A review of present reporting procedures will be made by the Aviation Safety Center to aid integration of analytical efforts.

Participating in the Conference:

R. G. Armstrong and Max Karant, Aircraft Owners & Pilots Assn.; Glen L. Amundson, University of Illinois Institute of Aviation; Galen A. Bertram, National Aviation Trades Assn., William K. Lawton, National Business Aircraft Assn.; Don Ahrens and Dwane Wallace, Cessna; Al Conklin, Aero Design & Engineering; Charles L. Walker, Alan Morse and George E. South, CAA; A. Howard Hasbrook, Aviation Crash Injury Research; Fred E. Weick, Texas A & M College; G. Edward Pencray, Guggenheim Foundation; C. E. Brown, National Association of State Aviation Officials; John Chamberlain; CAB; Melvin N. Gough, National Advisory Committee for Aeronautics; Cdr. Andred Bright, Aviation Safety Division, U. S. Navy; Lt. Col. J. C. Wright, Flight Safety Division, USAF; William E. Kelley, National Pilots Assn.; Kenneth Razak, University of Wichita; Joseph T. Geuting, Jr., Aircraft Industries Assn.; Paul Allen and Marvin J. Gordon, Beech; Jerome Lederer and R. Woodham, Cornell-Guggenheim Aviation Safety Center.

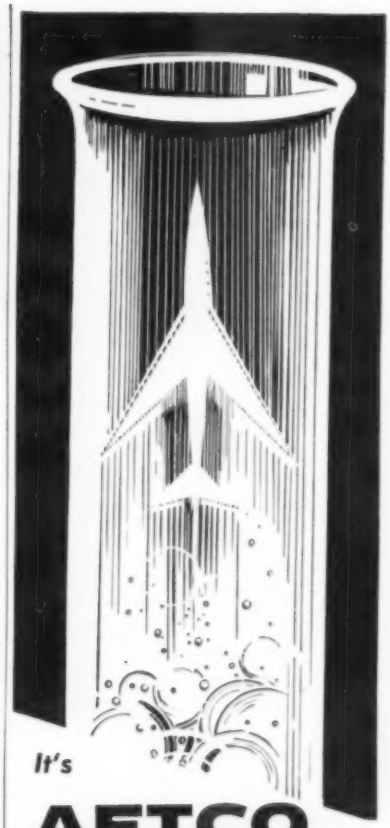
PRIVATE LINES

Forest fire fighting technique developed by U. S. Forest Service utilizes a dispenser tray fitted under a Bell 47G helicopter that can reel off 1,000 ft. of fire hose in 42 seconds. Tray is jettisonable in emergency.

Van Dusen Aircraft Supplies, Teterboro Airport, N. J., reports that its experimental scheduled route service to 16 metropolitan airports (AW May 13, p. 137) has proved successful. Firm takes phone orders for supplies up to noon of the day preceding delivery.

Landing lights for Piper Apache developed by Dallas Aero Service, Love Field, Dallas, Tex., are approved by Civil Aeronautics Administration. Installation weighs 3.5 lb., consists of 100-watt lights focused for 300-400 ft. or more from the airplane.

Aero Commander 560-A executive transport has been sold to Republic of Vietnam for personal use of President Ngo Dinh Diem by Air Carrier Service Corp., Washington, D. C. A long-range fuel tank has been installed so that the plane can be ferried to Saigon via the North Atlantic.



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THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

What Can Be Done About It?

There is no easy or quick way to overcome the shortage of scientists and engineers that has become a threat to our national security and economic progress. The solution can come only through diligent efforts extending over several years to bring the supply of technically trained people into balance with our needs. Meanwhile, the pressure of the shortage can be relieved if industry, government and education make better use of the limited number of scientists and engineers now available.

Earlier editorials in this series have discussed the dimensions of the shortage of technical manpower, its meaning for our national security and our economic well-being and the causes of the shortage. This final editorial will survey some of the measures that can be taken to overcome the shortage. Most of the proposals presented here have been suggested elsewhere. But in combination they appear to offer the best hope of an answer to this serious national problem.

Soviet Methods Not For U. S.

It is clear that no crash program, inspired by panic and designed indiscriminately to drive hordes of high school students into science and engineering, is suitable for the United States. Even if we adopted Soviet methods of channeling a large portion of our brightest young people into technical fields, it would be at least four years before results appeared in the volume of college graduates. And such an approach would do no credit to the American way of life.

Any crash program, whether it involved totalitarian methods or simply overselling the advantages of technical careers, would be objectionable for other reasons as well. It would jeopardize the quality of scientific and engineering training. It would put many young people in fields where they have little aptitude and deny them to other fields for which they are better equipped. And, if carried too far, it might even result in the overcrowding that was feared prematurely a few years ago.

The most important problems for the long run, as the preceding editorial in this series indicated, are in the area of education. Any real solution must reduce the loss of talented high school graduates who do not continue their education for financial reasons or because of lack of interest. Also, it must improve the quality of high school preparation in science and mathematics and, above all, relieve the critical shortage of teachers.

Basic Needs in Education

Substantial increases in salaries of teachers in most of the nation's school systems are essential if high school students are to receive adequate preparation for courses in science and engineering. Pay scales that have lagged behind rising living costs and salaries available in industry have placed great strain on even the most devoted teachers. There has been a sharp drop in the number of new graduates trained to teach science and mathematics, and of this smaller number many have decided not to follow careers in teaching.

Raising teachers' salaries to more realistic levels must be primarily the job of local school districts, aided by state governments. If, in face of rapid increases in school enrollments, local and state resources prove insufficient, then federal aid will have to be considered. Higher teachers' salaries, however financed, inevitably mean higher taxes. But without appreciable improvement soon, the quality of our entire educational system is in danger.

At the college level also, financial aid is needed to provide scholarships for promising students and to increase faculty salaries. (An earlier series of editorials dealt more fully with these problems, and business aid to higher educational institutions has been mounting at a gratifying rate.)

But not all the educational problems related to the shortage of scientists and engineers can be solved with money. Science and mathematics have steadily been de-emphasized as more youngsters have gone to high school for terminal education rather

How business is helping to relieve the shortage of technical manpower

Summary of a Survey by McGraw-Hill Correspondents

Sponsoring summer study programs for high school teachers

Arranging cooperative work-and-study programs for students

Sponsoring college fellowships and scholarships in science and engineering

Paying tuition of employees taking science and engineering courses

Keeping college faculties abreast of new developments in industry

Hiring high school science teachers for summer and part-time work

Giving old, but usable, laboratory equipment to schools

Cooperating in high school science exhibits

Sponsoring regional science fairs

Sending speakers and training aids to schools

Opening plants for student tours

Analyzing jobs to relieve engineers and scientists of routine work

The McGraw-Hill Department of Economics will be glad to hear of any other ways business is helping relieve the shortage.

than for college preparation. This de-emphasis must be reversed.

Techniques of instruction, furthermore, can stand improvement at all levels of education. Professor E. P. Northrup of the University of Chicago observes: "In the past fifty years . . . there has been a revolutionary change in the character of mathematics, yet not a trace of this change is to be found in the curricula of all but a handful of secondary schools throughout the country." Colleges and universities may have to examine old fetishes about light teaching loads and small classes in order to make more efficient use of their faculties.

What Industry Can Do

Industry has the immediate problem of better utilization of available technical manpower and the long-range responsibility of helping increase our resources of trained people. Frantic recruiting practices and reckless bidding up of starting salaries—financed largely by government money for defense orders — are not the answer. There is need for earnest consideration of incentives for experienced scientists and engineers, who too often must look to sales or executive positions for adequate financial recognition.

Industry in many instances could make more efficient use of engineers and scientists by shifting work to technicians, clerical personnel and even machines. One company found that 15% of the time of an engineering design group was spent on routine jobs and that this valuable time could be saved by adding a technician and a clerical worker to the group.

Other potential sources of technical manpower could be tapped more extensively to relieve the shortage. Very few women have entered what has been traditionally a man's world. Negroes are only slowly gaining educational and employment opportunities in technical fields. And many experienced older men can still give useful service.

A Good Beginning

Much is being accomplished already in efforts to attract more young people into scientific and engineering careers. A summary of some of the things business is doing is presented above. Other notable contributions are being made by such organizations as the professional engineering and scientific societies (especially through their manpower commissions), the National Science Foundation, the National Research Council, the National Education Association, the National Merit Scholarship Foundation and the Thomas Alva Edison Foundation.

Results are beginning to appear in rising enrollments in engineering schools and technical institutes. Between 1951 and last year, according to McGraw-Hill's annual survey of technical institutes, enrollments in these schools rose from 46,000 to a record 67,000. Engineering enrollments rose in the same period from 166,000 to 243,000. A rising tide of graduates is already being made available to American industry.

This is a good beginning. But only with wider appreciation of the serious implications of the shortage of scientists and engineers and intensified efforts on the part of business, government and education to relieve the shortage can we hope to overcome this threat to our national security and economic well-being.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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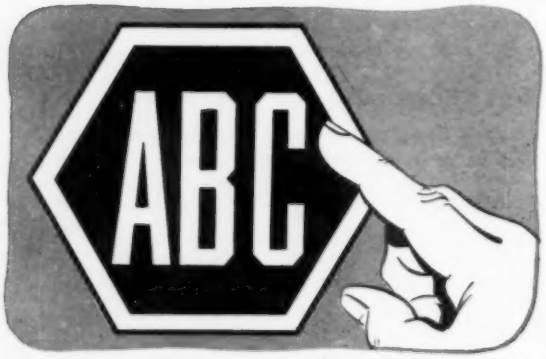

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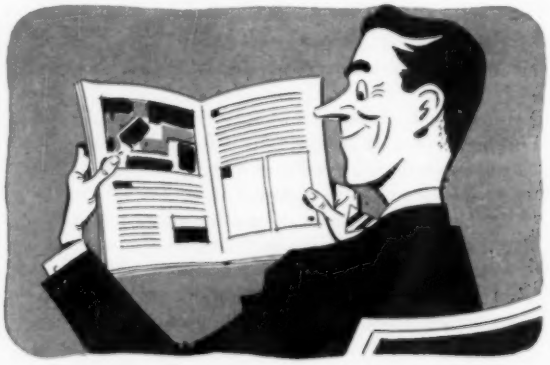

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CAB Accident Investigation Report

'Missed Approach' Ruled in Eastern Crash

At 0343[1] Dec. 21, 1955, a Lockheed Constellation, model L-749A, N 112A, owned by Eastern Air Lines, Inc., and operated as Flight 642, crashed during an ILS (Instrument Landing System) approach to runway 5, Imeson Airport, Jacksonville, Fla. The aircraft was destroyed by impact and fire and all 17 occupants, including the crew of five, were killed.

Flight 642 originated at Miami, Fla., with its destination Boston, Mass.; Jacksonville, Fla., was included as an intermediate stop. The captain was briefed by the company forecaster on the en route weather and terminal forecasts, and following the briefing the flight was dispatched to Jacksonville on an IFR (Instrument Flight Rules) flight plan. This plan specified a flight to be made via Victor Airway 3 at a cruising altitude of 11,000 feet. The crew consisted of Captain Thomas F. McBrien, Pilot John J. Rinyu, Flight Engineer Charles C. Devine, and Flight Attendants Emma Williams and Clara Rioseco. There were 12 passengers on board.

Flight 642 was scheduled to depart Miami International Airport at 2340, Dec. 20, but because of the late arrival of an inbound flight using the aircraft involved, departure was not made until 0212, Dec. 21. According to company records, the gross weight of the aircraft at the time of departure was 85,944 pounds, which was under the allowable takeoff gross weight of 107,000 pounds; the load was properly distributed.

Routine en route radio reports were made and at 0315 the flight reported over Daytona Beach at 11,000 feet, estimating Jacksonville at 0336. This report was made to the company's Jacksonville station and at this time the flight was given the Jacksonville 0248 U. S. Weather Bureau special report: "Thin obscuration, 2 miles visibility; ground fog; wind north-northwest 6 miles per hour; 30 per cent of sky obscured." After this message was acknowledged, the flight was given the following clearance: "Jacksonville air route traffic control clears Eastern Air Lines Flight 642 to Jacksonville middle marker ILS, cross middle marker ILS at 2,500 feet, maintain 2,500 feet until further advised. Contact Jacksonville approach control when over Sunbeam Intersection." The clearance was acknowledged.

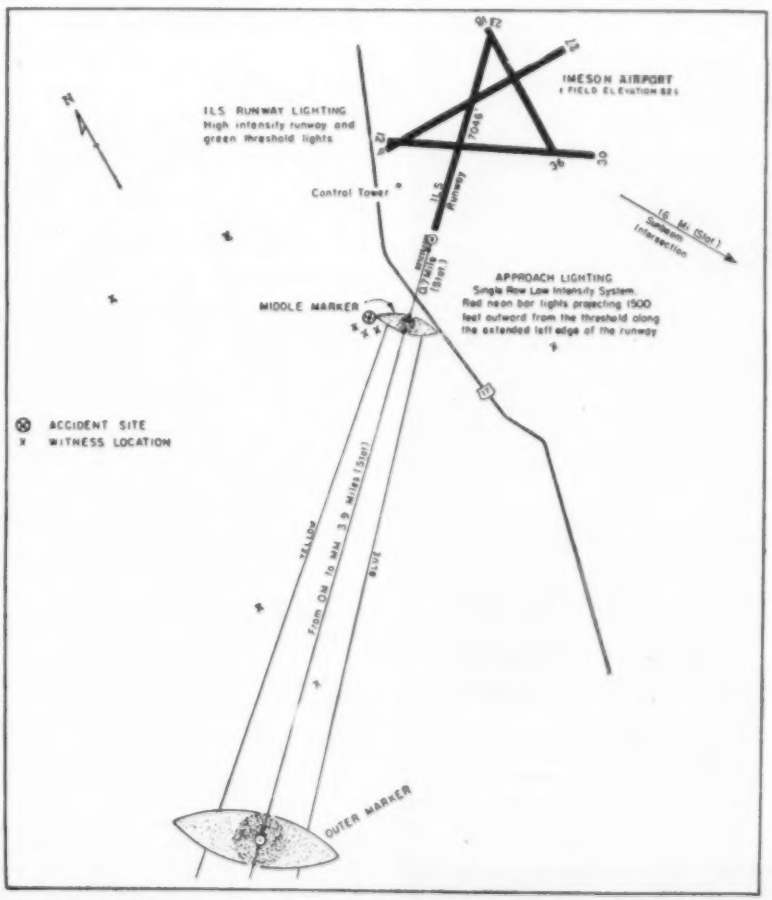
Flight 642 contacted Jacksonville approach control when over Sunbeam Intersection (16 miles SSE of Imeson Airport) at 0331, and was cleared for an ILS approach to runway 5. At the same time the Jacksonville weather was given as: "Partial obscurement; visibility one-half mile; altimeter 30.18." Immediately following this transmittal another message was given the flight: "Coming out with indefinite 300 obscurement now one-half with fog." (Eastern Air Lines' Constellation minimums for ILS approaches at Jacksonville, day or night, are ceiling 200 feet, visibility one-half mile.)

After acknowledging this weather information, Flight 642 reported leaving Sunbeam at 2,500 feet. Following a later query from the flight, approach control advised that there was no other known traffic in the area, and requested the flight to report when over the outer marker inbound. Flight 642 reported over the outer marker inbound and was cleared to land.

Shortly thereafter the tower controller observed a large flash in the vicinity of the ILS middle marker. Calls to Flight 642 were not acknowledged and an emergency was declared by the controller. It was subsequently learned that N 112A had crashed approximately six-tenths of a mile southwest of the threshold of runway 5.

Investigation disclosed the main portion of the wreckage to be 212 feet northwest of the ILS middle marker and 3,486 feet southwest of the threshold of runway 5. The time of the accident was established as 0343.

First impact of the aircraft was with the top of a small pine tree approximately 200 feet below the ILS glide path, 260 feet to the left of the extended centerline of the runway, 4,000 feet from the threshold of runway 5, and 420 feet southwest of the middle marker. This was followed by striking a 50-foot oak tree, the upper 20 feet of which was sheared off. The aircraft settled toward the ground, striking other large trees which disintegrated both wings and a portion of the empennage. Ground contact was on a heading approximately 55 degrees magnetic. The distance



SITE where an Eastern Air Lines Constellation crashed near Jacksonville, Fla., is marked by cross in circle. Seventeen persons, including five crewmen, were killed.

[1]All times herein are eastern standard and are based on the 24-hour clock, altitudes are mean sea level.

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from the first tree struck to the farthest piece of wreckage was 801 feet. Explosion and fire occurred immediately upon impact.

The cabin and cockpit areas were completely consumed in the ground fire with the exception of the lower fuselage skin and portions of the cabin flooring. The fuselage aft of the rear pressure bulkhead and the center rudder fin and portions of the stabilizer were intact, but with surface scorching indications. The tail cone was found in a relatively undamaged condition with the control booster mechanisms in proper position.

Outer portions of the left and right wings had been separated from the main structure during the passage through the trees and along the ground. The "speedpack"[2] was torn from the bottom of the fuselage at ground impact. Wing flaps were determined to have been in the 60 percent extension position, and their positions were symmetrical at the time of impact.

Control systems were examined and no evidence was found to indicate failure prior to impact.

Separation of the right main gear and part of the nose gear had occurred at ground contact. The left main gear was intact and in the extended and locked position; the cockpit landing gear lever was found in the "down" position. Measurement of the right main gear actuating cylinder piston rod revealed the same 15 inches as found on the down and locked left main gear actuating cylinder piston rod.

Cockpit instruments were largely destroyed by fire; readings obtainable gave evidence of routine operation. Radio equipment reflected settings for a normal ILS approach with appropriate frequencies for Jacksonville approach control and Jacksonville ILS, including glide slope and the ILS middle and outer markers.

Boost Controls

All boost control assemblies were found in the "boost on" position. A bench check revealed that all boost actuating cylinders had normal travel in both directions and showed no signs of abnormal internal leakage.

Relief valves and bypass controls operated normally. The filters showed a normal differential pressure between inlet and outlet. The elevator boost was installed in a similar aircraft and flight tested. It functioned in a normal manner.

On impact the four powerplants separated at their attach points and came to rest a few feet ahead of the main wreckage. Number 4 engine suffered extensive damage in the ground fire. Examination of the interiors of all four crankcases gave no indication of rotational or reciprocating interferences or operating irregularity of any kind. All oil pumps were free of metal particles and revealed no scoring. There was no evidence to indicate that the engines were not capable of developing power prior to impact.

All propeller blades were broken or bent, with bending generally rearward, and five of them were broken at the butt ends. The dome position and blade angles were found to be in settings that indicated normal operation of all engines.

Computations made by using the distance between the slash marks of the blades of one propeller, and the determined revolutions per minute setting of its governor, indicate a speed of approximately 140 knots at impact.

The tearing free of all powerplants resulted in the pulling and breaking of control cables under tension. Several of the cable-controlled fuel shutoff valves were found in the closed position; the electrically controlled firewall fuel shutoff valves were all open.

From markings presented by ground object contacts of the airframe and propellers it was determined that just prior to impact the airplane was in a slight turn to the right and banked approximately 11½ degrees. The longitudinal attitude of the airplane was approximately 4¾ degrees nose-up and the angle of descent during the last 200 feet of the flight path was about 2½ degrees, with the rate of descent being 10 feet per second.

Ground Checks

Several flight checks of ground navigational facilities soon after the accident showed operation of the systems to be normal. Simulated ILS approaches were made, with a Board investigator as observer, to determine the effect on cockpit instruments caused by vehicles parked on the highway below the glide path. The highway is about 100 feet east of the middle marker. On one approach, with a crane-equipped truck parked beneath the glide path, a fly down indication was noted prior to reaching the middle marker. It was necessary to descend 60 feet in order to center the needle. However, the glide path indication was found to be normal at the middle marker, where the accident occurred.

Several persons saw or heard the aircraft, with normal engine sound. A power surge was heard just before impact. One witness, who was near the middle marker, said he first saw the landing lights, lighted and pointing straight down, and that they partially extended before he lost sight of the aircraft. Other witnesses near the accident scene did not see the landing lights on. Subsequent investigation disclosed that the right landing light had been destroyed but the left light was found in the retracted position. There was no fire observed by any witness prior to impact. One witness saw the aircraft, at a very low altitude, make a slight turn to the right just before it contacted the trees and ground (see map p. 79).

A witness who was driving a trailer-truck south along the highway adjacent to the airport said he saw what he believed to be two jet-propelled aircraft pass from right to left in front of him, flying at an altitude of 150-250 feet. He stated that at the same time he observed these aircraft he saw a bright flash, whereupon he immediately stopped his truck and walked down the highway. To his right he saw scattered parts of an aircraft burning. He also said that before reaching the airport he had passed through patches of ground fog, that at the airport there was an overcast condition, and that he again passed through patches of ground fog as he continued south.

The two airport tower controllers in radio contact with the flight stated they

[2]A large detachable cargo compartment positioned on the underside of the fuselage.

heard it pass over the south edge of the field, proceeding outbound. At this time the runway lights were on at their highest intensity. One of the two controllers on duty stated that he went downstairs to the radar room and, on the ASR (Airport Surveillance Radar) scope, observed the flight just before it reached the outer marker outbound.

He also said he saw the start and completion of a procedure turn and observed the aircraft start inbound, after which he gave the flight its three-, two-, and one-mile range positions. The tower recording of outgoing messages does not include the three-mile position message. The ASR equipment at Jacksonville does not show altitude above the ground. The controller stated that forward movement ceased soon after the image of the aircraft on the scope passed the one-mile position from the end of the runway. This radar observation coincides with the geographical position of the crash.

During the entire time the controller was watching the scope, set to 10-mile range, he saw no other aircraft. Comprehensive investigation revealed no other traffic, either civil or military, in the area during the approach of the subject aircraft.

Several months after the public hearing the Air Line Pilots Association gave the Board names of persons it believed could present additional evidence that might establish the presence of jet aircraft near the scene of the accident at the time it occurred. Accordingly, the Board took depositions of these witnesses in Florida. In addition, a deposition was taken of the truck driver who had said he saw jet aircraft flying in the vicinity at the time of the crash. (This truck driver had previously given a CAB investigator a clear and concise statement which had been carefully evaluated.)

One of the witnesses suggested was an airline captain who stated that about a month after the accident, while flying near the outer marker at Jacksonville, he observed several jet aircraft beneath him through a hole in the clouds. He said that tower personnel had no knowledge of these aircraft and therefore could not advise his flight to be on the alert for them. Tower personnel on duty at the time were questioned but did not remember the occurrence. None of the witnesses questioned presented any pertinent evidence that had not been previously evaluated.

As jet aircraft were reported being seen by witnesses but were not seen by experienced radar scanners, it was decided that test flights were necessary to determine if jet aircraft flying at low altitudes could be seen on the radar scope. With the cooperation of the Florida Air National Guard, such flights were made. A jet aircraft was flown at altitudes ranging from 150 to 600 feet above the ground at an airspeed of 350 mph. These flights, made both near the scene of the accident and the outer marker, were all observed on the radar scope by a CAB investigator, as well as by CAA personnel. Throughout the tests the aircraft was never lost from sight for more than one sweep of the scope.

Captain McBrien and Pilot Rinyu were familiar with Imeson Airport. Company records disclosed that Captain McBrien had made 17 landings at Jacksonville during 1955, five being in the month of December. The records also indicate that Pilot Rinyu had recently made landings at this airport.

The night of Dec. 20-21 weather stations from Miami to Savannah, Ga., were reporting a small spread between temperature and dewpoint. The company terminal forecast for Jacksonville was ceiling and visibility unlimited; this was not amended until 0345 when it was changed to ceiling 300 feet; broken clouds; visibility three-fourths of a mile; fog. During the briefing the company forecaster advised the crew that patchy ground fog could be expected in the Jacksonville area.

Shortly after the flight reached the Jacksonville area the weather was being reported as ceiling indefinite 300 feet; sky obscured; visibility one-half mile and fog. This observation was given to the flight before the ILS approach began.

Exact visibility conditions at the crash scene are not known but all indications are that they were similar to those reported at the airport.

About 15 minutes before the accident occurred an aircraft of another airline was making an instrument training flight in the vicinity of Jacksonville. As a part of this training the flight completed an ILS approach to Imeson Airport and landed there at 0328.

Reporting on the weather conditions at that time and the operation of the navigational facilities, the captain stated that the tops of the clouds were approximately 450 feet with their base at 300-250 feet, and that all facilities operated in a normal manner.

He also said the airport appeared to be covered by a broken to overcast stratus cloud condition which seemed to him to be caused, in part, by smoke from adjacent mills. He said he entered this obscurement near the middle marker and that the weather elsewhere was spotty to clear.

An Eastern Air Lines airplane flying south at an altitude of 22,000 feet was over the airport at the time of the accident. The captain of this flight said he saw a brilliant flash, and saw the flames of the burning aircraft. He described the clouds below him as wavy in form with vertical visibility very good, looking through the troughs, and reduced somewhat when looking through the crests. He further said he could easily see the approach lights, lights of the airport, and lights of neon signs along the adjacent highway.

ANALYSIS

It is evident that all components of the ILS system (outer marker, middle marker, glide path, localizer, approach lights, threshold and high intensity runway lights), were operating normally at the time of the accident. This was also indicated by another flight which made an ILS approach and landing approximately 15 minutes before the accident. At that time the system was normal, as it was on two approaches made several hours after the accident.

Monitoring records of the system gave no indication of any deviation from normal operation during the early morning of Dec. 21. All contacts with Flight 642 by Jacksonville approach control were routine and the crew did not report any

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operating difficulties. The flight had been given all necessary altimeter and weather information.

The testimony of witnesses who observed the landing lights of the aircraft come on during the approach, and other witnesses who saw no landing lights, is not completely incompatible. Since the lights were found in the retracted position it is indicated that once lowered they might have been retracted to eliminate reflection as the aircraft descended into the layer of fog. Also, some witnesses heard a surge of power just before impact with the trees, which indicates that the pilot was attempting a pullout.

Every possible effort was made to account for the jet-propelled aircraft being in the area when the accident occurred. All military services were contacted and each said they had no jet aircraft flying in that area at the time of the accident. Neither the tower personnel, witnesses on the airport, nor witnesses other than the truck driver near the accident scene saw any jet aircraft and such aircraft were not observed on the radar scope.

In view of the truck driver's testimony, the Florida Air National Guard, under the direction of a CAB investigator, made several flights (using a jet aircraft) in an effort to simulate the conditions described by the truck driver. Each of these flights was plainly visible on the radar scope. It therefore is concluded that no such aircraft were in the vicinity.

The crew filed an IFR flight plan prior to leaving Miami and gave as the alternate Orlando, Fla. The flight to Jacksonville was made in clear weather and clouds or obscuration were not encountered until in the vicinity of Jacksonville.

From the testimony of other pilots flying in the vicinity a short time prior to the accident, there was a layer of cloud, which included smoke and fog, capping the airport with a general foggy condition existing a few miles to the southwest. All other areas appeared to be clear. It therefore appears likely that Flight 642 was clear of clouds from the Sunbeam Intersection to the middle marker and outbound to the outer marker, and that it probably did not encounter obscurement until in the vicinity of the middle marker inbound.

Although this weather condition has been described as partial obscurement with horizontal visibility of one-half mile, it is apparent from the testimony of pilots that vertical visibility throughout the area was generally good. Some of the witnesses said the ground visibility at and near the accident was poor. There is no way of determining ceiling height or visibility distance at the accident site. However, the weather information reported to the crew was obtained at the control tower.

The tower is located approximately one mile north-northeast of the accident scene. At the time of the accident, a wind of six knots was blowing from the north-northwest, and it is believed that between the time of the last reporting and the accident the weather conditions at the observation point could have moved to the general area of the accident and therefore should have been essentially the same as that reported to the crew, "Indefinite 300, sky obscured; visibility ½ mile and fog."

Visibility Decrease

Assuming that weather conditions were similar at the crash point and the observation point, consideration should be given to the decrease of horizontal visibility with elevation. Horizontal visibility must have been near zero at 300 feet above the ground. Normally, slant visibility down the glide path should have gradually increased as the aircraft descended.

As previously mentioned, the radar scope at Jacksonville does not reflect altitude. However, since the radar operator testified that the aircraft was observed to fly beyond the outer marker, make a procedure turn, and return inbound, it is believed that this was accomplished at the normal altitude of 1,200 feet. The propeller slash marks at the scene indicated the speed of the aircraft at impact to be 140 knots. The company's instructions for this type aircraft show a recommended approach speed of 115 knots from the outer marker to the minimum authorized altitude.

Evidence indicates that the aircraft was flying in a normal manner just prior to impact and there is no known evidence to indicate any malfunctioning of the aircraft or any of its components. The flaps were extended to a position used for maneuvering and this amount of flap extension is usually used in this type of approach until reaching the middle marker.

Although the aircraft was 200 feet to the left of course this is a small deviation at that point in the approach and only a slight correction would have been required to again align with the runway. The fact

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that the airplane was in a slight right turn and almost level horizontally at impact would suggest that the pilot was turning toward the localizer course, further indicating the aircraft was under control.

It is not unusual, with weather conditions such as existed this day, for pilots during an approach to an airport to find ceilings and visibilities that vary from those reported. These variations may be either on the low or high side. If, on the morning of the accident, Captain McBrien found the visibility to be lower than one-half mile, it would then have been his responsibility to execute a missed-approach procedure.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The aircraft, the carrier, and the crew with one exception were currently certificated.
2. The aircraft's gross weight at takeoff was under the maximum allowable gross takeoff weight, and the load was properly distributed.
3. The flight was routine to Jacksonville and the start of the final approach.
4. No evidence of failure of the airframe, powerplants, controls, or other components was found.
5. The weather at the airport was marginal with local fog and restricted visibility; however, at last report the weather was above the carrier's minimum.
6. Ground navigational facilities in the Jacksonville area, including the ILS system, functioned normally during the approach.
7. There was no operating difficulty reported by the crew.
8. There were no other known aircraft in the immediate area.
9. The crew applied power too late to avoid striking the trees.
10. Trees were struck six-tenths of a mile from the runway threshold more than 200 feet below the glide path.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was that the flight encountered local fog and restricted visibility during the final portion of an ILS approach, and a missed approach procedure came too late to prevent the aircraft from descending into ground obstructions.

By the Civil Aeronautics Board:

/s/ Joseph P. Adams
/s/ Chan Gurney
/s/ Harmar D. Denny
/s/ G. Joseph Minetti

Durfee, Chairman, did not participate in the adoption of this report.

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at approximately 0400, Dec. 21, 1955. An investigation was immediately begun in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Six depositions were taken in Jacksonville, Fla., on Jan. 23, 1956, and a public hearing was held in Coral Gables, Fla., on Jan. 26 and 27, 1956.

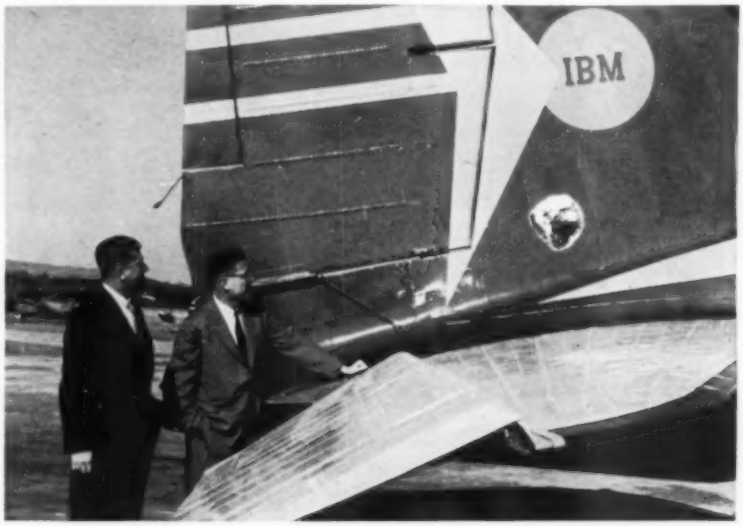
Eastern Air Lines, Inc., is a Delaware Corporation and maintains its principal office at New York, N. Y. The company possesses certificates of public convenience and necessity issued by the Civil Aeronautics Board and air carrier operating certificates issued by the Civil Aeronautics Administration which authorize the carriage of persons, property, and mail over the route described in this report.

FLIGHT PERSONNEL

Captain Thomas Francis McBrien, age 43, was employed by Eastern Air Lines Oct. 20, 1942, and promoted to captain May 29, 1946. He held a currently effective airman certificate with ratings of airline transport pilot, single- and multi-engine land, DC-3, Martin 4-0-4, Constellation, and flight instructor. Captain McBrien had, according to company records, 12,052 hours of pilot time, of which 2,501 hours were acquired in Constellation aircraft.

He passed a line check in L-749 aircraft on April 4, 1955, and an instrument check in L-1049 aircraft on July 22, 1955. His last first-class physical examination was passed August 31, 1955. Rest period prior to the subject flight was 16 hours.

Pilot John Jay Rinyu, age 37, was employed by Eastern Air Lines April 16, 1951. He held an airman certificate with ratings of commercial pilot, single- and multi-engine land, and instrument. Pilot Rinyu



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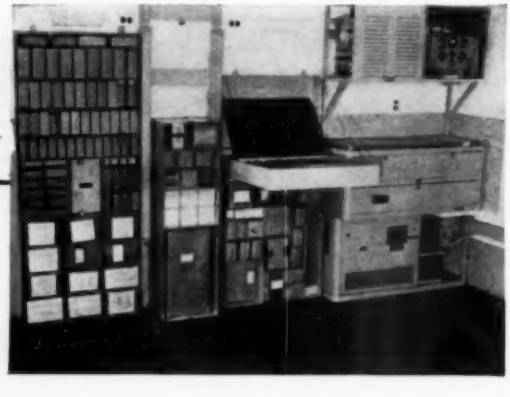

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had, according to company records, 9,522 hours of pilot time, of which 1,360 were acquired in Constellation aircraft. His last hood check was Oct. 17, 1955, and he requalified on L-749 aircraft Dec. 1, 1955. His last CAA first-class physical examination was passed April 1, 1954; therefore he was not currently certificated according to Civil Air Regulations. A company physical was passed on Aug. 25, 1955. Rest period prior to the subject flight was 16 hours.

Flight Engineer Charles Calvin Devine, age 30, was employed by Eastern Air Lines, May 9, 1955. He held a currently effective airman certificate with rating of flight engineer. Mr. Devine had, according to company records, a total of 332 hours flying time, all of which had been acquired in Constellations. He also had 4,800 hours as a flight mechanic in the U. S. Air Force. His last CAA physical examination was taken Aug. 23, 1955. The date of his last line check was Oct. 5, 1955. Rest period prior to the subject flight was 15 hours.

Flight Attendant Emma Elizabeth Williams, age 21, was employed by Eastern Air Lines February 16, 1955, as a student flight attendant and was promoted to flight attendant March 8, 1955.

Flight Attendant Clara Dorothea Riosecco, age 23, was employed by Eastern Air Lines, October 20, 1954, as a student flight attendant and was promoted to flight attendant November 8, 1954.

THE AIRCRAFT

N 112A, a Lockheed model L-749A Constellation, serial number 2533, was owned by Eastern Air Lines, Inc. Its manufacture was completed as a model 649-79-12 aircraft on August 1, 1947, and converted to a 749A on September 7, 1950, in accordance with CAA specification No. A673. Total flight time on the airframe was 29,941 hours. Powerplants were four Wright Cyclone engines, model 749C18B1, equipped with Hamilton Standard model 43E60 propellers. Time since overhaul on the engines varied between 488 and 1,337 hours (approved time between engine overhauls is 1,925 hours). Time since overhaul on the propellers varied the same as on the engines (approved time between overhauls on propellers is 3,850 hours).

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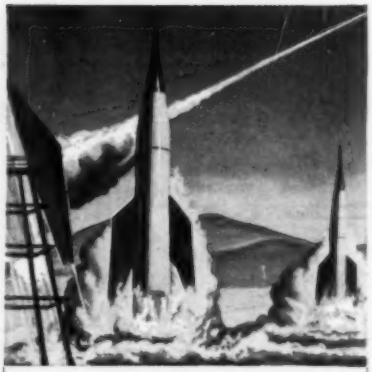

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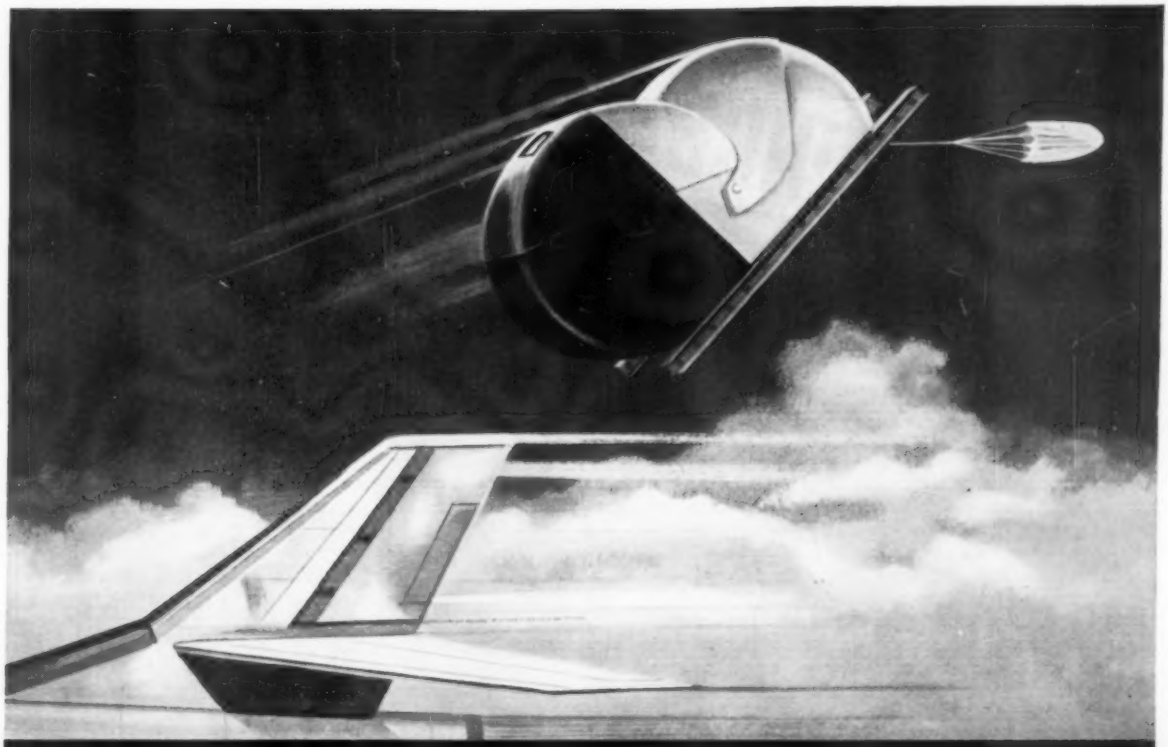

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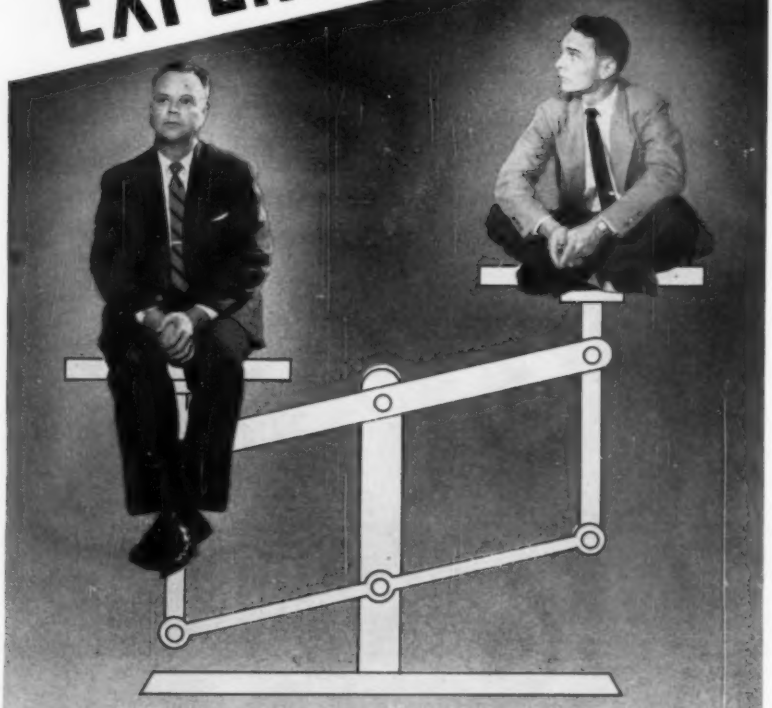

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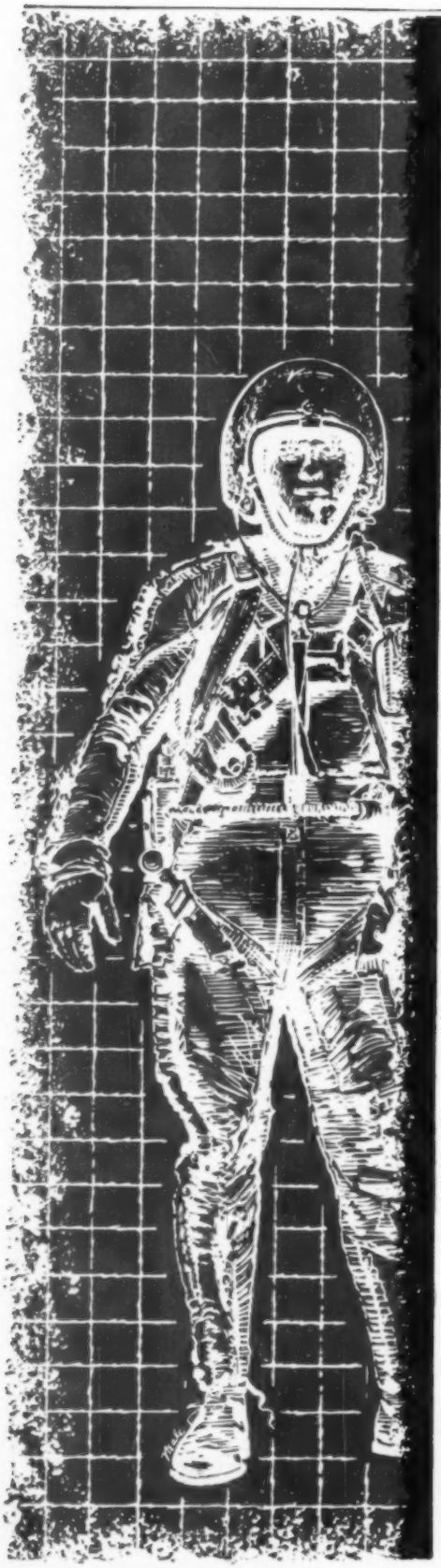

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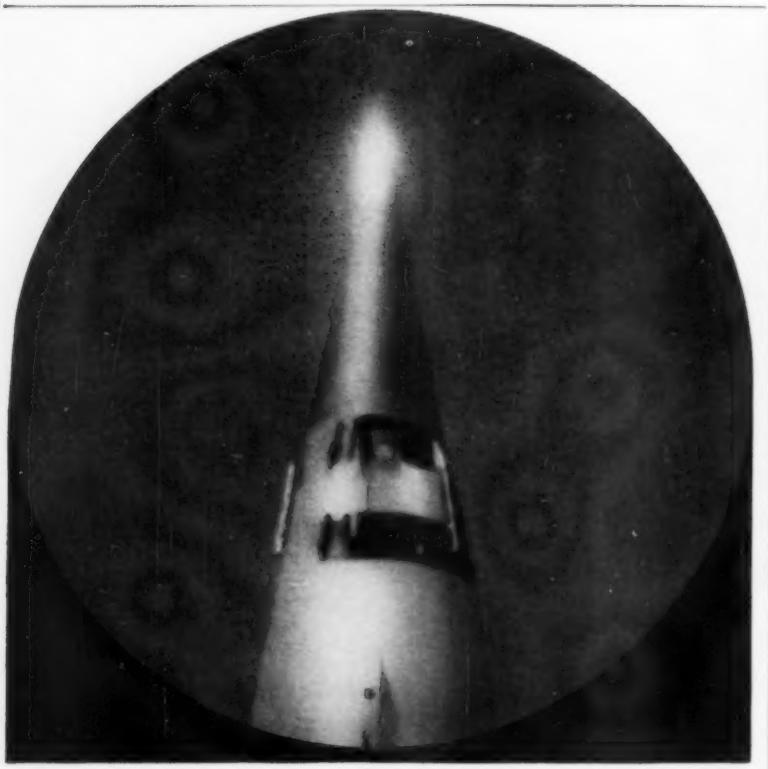

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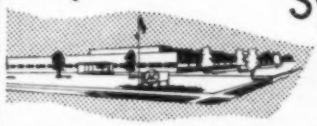

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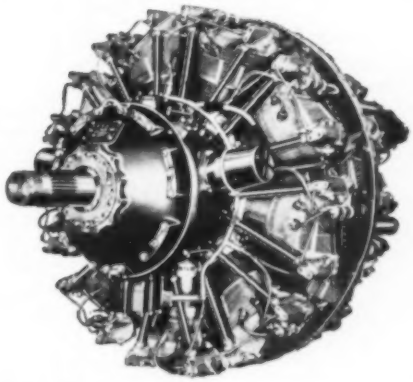

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1	24100-14B-4-A1	Hyd. Press Indicator
6	EA528-BF-739	Transmitter
4	Mod. TJ56A	Telemeter
73	TTO-1A	Position Meter
23	TA-12B	Transmitter
8	BC-733D	Receiver

ACTUATORS

Quantity	Part No.	Manufacturer
493	G-904X	White Rodgers
22	GYLC4163	
12	189W	
10	R170-M1	Airborne
1	R170-M6-3	Airborne
1	R174-M6-9	Airborne
2	R174-M6-10	Airborne
1	R174-M6-11	Airborne
3	D15485-15	
6	D15485-16	
1	164CVL-1A Mod. A10087	Lear
2	164BK Mod. 10065	Lear
1	164KP1 Mod. 100AP1	Lear
8	164RT-2 Mod. BBO5A1	Lear
4	164DP-4 Mod. A100AP	Lear
3	111CJ	Lear
4	R11	Airborne
2	400JE Mod. BC10N-1	Lear
1	400DA Mod. A100A4	Lear
147	420DY	Lear
159	420EC	Lear
1	400FJ Mod. A100AW1	Lear
9	M2031	Air Associates
19	25040	Airesearch
354	30626	Airesearch

CYLINDERS

Quantity	Part No.	Manufacturer
34	MB700368	Walter Kidde
16	WK-982510	Walter Kidde
1	982511	Walter Kidde
5	982511-915	Walter Kidde
33	WK982512B	Walter Kidde
205	870491	Walter Kidde
97	870979	Walter Kidde
43	M870036	Walter Kidde
6	870038	Walter Kidde
15	981564	Walter Kidde

VALVES

Quantity	Part No.	Description
144	K702FG-6D	
25	N654	
66	#228	Unloader
8	AA37001	
56	184-T	Emergency
25	196-4-5	Regulator
75	40R493	
463	40R1201	Solenoid
14	SK16	
67	19-100-2	Check
56	10-1540-2	
33	NOA 1064-1	
28	D1100-D-1	
10	D1100-D-1A	
16	D100-D-2	
52	LGA-10FD	Iris
282	IV40-210	Iris
14	K1207-8-16	
555	SK1213-108	
7	74345-2	Selector
33	#1640	Supercharger
13	NC2099-M3	Sequence
23	2432-2	Selector
12	2433-3	Selector
44	92980	
5	92420-2	
10	17589-2	
8	90420-2-50	
1	92439	
35	SW470544A	
20	B12906	Selector
31	702-FG-8D	Selector
5	37D6114	Selector
21	A8182-6	Relief
233	1265-900	
32	1408	
9	11145-2	
8	20448-2	
18	SP7-2646-12M2	
12	12-2744-79	
2	24257	
28	982499	
4	982051	
4	12880-2	
7	22887	
9	AN6279-8 (HPLY-A1-M2)	
14	6-2050-2	
122	K-709-GG-6D	
3	MFC-6-01	
15	25352-2	
30	SP2-2846-16M4	
2	SP4-1846-2	
1	AN6206-1-2	Regulator
75	8326-90	
8	AA1133681	Relief
6	2622004N	Pressure
8	AA4106728	
177	8504938	

TRANSFORMERS

Quantity	Part No.	Manufacturer
139	MPT6	
217	TF1A01AH, NYTC, 32528	
79	MPT5	
53	BX1256	Baltn. Trans. Co.
76	BX341	Baltn. Trans. Co.
2	BX838	Baltn. Trans. Co.
1	BX839	Baltn. Trans. Co.
30	HS71	Baltn. Trans. Co.
100	C9960, 276V	Baltn. Trans. Co.
79	BX17-16	Baltn. Trans. Co.
1	BX30	Baltn. Trans. Co.
1	BX96	Baltn. Trans. Co.
3	BX492 (X1226-2B)	Baltn. Trans. Co.
3	BX600	Baltn. Trans. Co.
2	BX601	Baltn. Trans. Co.
5	626783	
76	C768696-1	Eclipse-Pioneer
1	S1147	Superior Elec.
2	68G828	General Electric
8	O-9	
25	HQ8-9	United Trans. Co.
1	R73	United Trans. Co.
2	R74	United Trans. Co.
15	R72	United Trans. Co.
8	HBQ-2	United Trans. Co.
5	8P202GL	SMC Mfg. Co.
6	RH-8200	Chicago Trans. Co.
1	PHR-200	Chicago Trans. Co.
7	PHC-40	Chicago Trans. Co.
4	PHC-200	Chicago Trans. Co.
3	FH-210	Chicago Trans. Co.
6	P-8130-115	Standard Transformer Co.
2	PC-8406	Standard Transformer Co.
7	P-4019	Standard Transformer Co.

MOTORS

Quantity	Part No.	Quantity	Part No.
174	EYLC2334	44	5BA25D-J4B
33	EYLC2434	483	5BA40NJ1A
47	FD65-6	189	5PD 65-MB1
21	MML-28F	6	A42A9390
26	1225D-0460-02	3	BYLM41001
99	#1300	16	32710
43	RDB2220	26	1225D-0460-02
13	26675	34	7100F 24V-DC .625 RPM Timing Motor
21	FD65-5		

ENGINES

Quantity	Part No.	Description
268	R2600-20	Wright
5	1820-97	Wright
4	3350-57	Wright
1	1830-43	Pratt-Whitney

SPECIAL PARTS

Quantity	Part No.	Description	Manufacturer
385	Mod. 564-2A	Oil Separator	
73	AL 599	Drive Assembly	
887	B107-19	Brake Line Assembly	
41	#1334	Cylinder Lock Assembly	
465	417033	Crankcase Assembly	
33	420313	Pump Assembly	
46	416421	Drive Assembly for R1820-97	
78	200-03-19	Cap Assembly	East Coast Aeronautical
13	MP2 8BA	Power Unit	
1	81075	Turbine Heat Exchanger	Airesearch
18	SW472083	Heater Exchanger	
6	83A94	Heater	Surface Combustion
2	C97A49	Heater	Surface Combustion
7	C97A28	Heater	Surface Combustion
261	1033-4E1	Heat Control Switch	White-Rodgers
22	A55A00	Heater Ignition Switch	Surface Combustion
18	4582-A-A-6G	Blower	Dynamic Air
36	9804B	Control Box	Vapor Car
804	58G926	Ballast	General Elec.
395	58G946	Ballast	General Elec.
67	58G927	Ballast	General Elec.
8	902009	Reducer Accumulator & Adapter	
5	Type AV14C 2.4V	Control Valves Motor	
22	AYLF2109-3	Temperature Bulb	Barber-Colemen
154	BX42-7	Dynamotor	
160	68G264	Inverter	
4	80170-2-80170-1-114	Water Separator	
51	412-5 Type PR	Filter	
1527	E10516	Filter	
397	417033	Nose Assembly	
53	48362	Shaft for 1830-43, 90, 92	
75	48363	Shaft	

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Buyers' Guide

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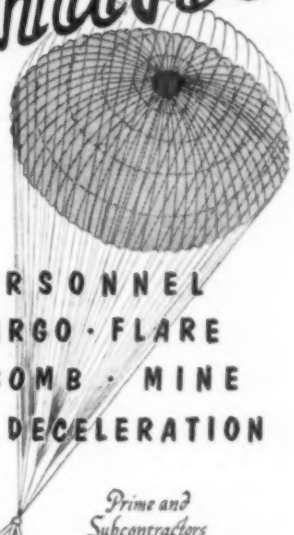

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LETTERS

Brotherhood of Bodge

Through the years of taking AVIATION WEEK I have been pleased with the true and factual reporting on British military and civil aviation. To keep abreast of my ignorance on what goes up here in England, I have time and time again to resort to AVIATION WEEK. I was further pleased to see the "press" you gave Bill Waterton and his book on the Javelin, especially as the technical press gave him such a rough handling here.

However, when one has full page spreads from important manufacturers it is, of course, necessary to be circumspect in one's comment.

What has really made Waterton red-out has been the eternal Brotherhood of Bodge of the industry here.

No matter what errors are made, no matter who gets killed—not one word of criticism must be uttered. A typical example of this was the Comet. With the hitherto accepted push-through-or-bust attitude of de Havillands, they pushed through and sprayed some 90-odd souls over the Mediterraean. Just how much the experts were wrong can now be computed by the enormously increased strength factors of the new Comet design. When Farnborough finally got through bending bits of metal they vouchsafed the opinion that the Comet was reasonably good for 2,000 hr. flying. No one asked why de Havillands and the Air Registration Board could have been so hoodwinked by the Mau Mau of modern metallurgy—fatigue; no one asked such searching questions as to why two such illustrious bodies of aeronautical learning could have been tripped by the same snare. If you look at the rostrum of the Air Registration Board you will find the manufacturers strongly represented. Imagine what would happen in the U. S. if Don Douglas was appointed chairman of CAA. I'd be able to hear the scream here in London. I have often wondered why we do not let the manufacturers write out their own Certificates of Airworthiness and save hundred of "jobs for the boys"?

And the Javelin, what do we in England know about it? Only what we read in AVIATION WEEK and other foreign magazines. In our own daily press we regularly get releases concerning our mighty air arm, what it will go—when we get delivery of it.

Half a dozen obsolete or gunless aircraft fly over London on somebody's birthday, and everybody goes to bed, fat, dumb, and happy! Only one paper has dared to splash the whole post-war dreary story of British aviation, and Bill Waterton's hand was responsible for that, too!

What the British taxpayer has paid out for junk aircraft straight from the production lines runs into a nine figure number, and not in dollars. For my money, Bill Waterton is more important to the British aircraft industry than any other single person, if only for the sole reason, whilst committing the unforgivable sin in this bear Garden of Eden, of having the guts to write the truth about the hand that has fed him.

In Britain, where it is more acceptable to be pro-Soviet than pro-American, Bill Waterton has committed professional Hari-Kari, as does anyone who dares criticize the Brotherhood of Bodge.

MICHAEL J. CONRY
49 Old Bond St.
London W. 1., England

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Business Planes

I would like to take this opportunity to inform you that I appreciate your articles on the Aero-Commander 680 Super (p. 82) and the Cessna Model 620 (p. 96) in your Oct. 1 issue.

I believe that more material concerning private and business aviation, will serve to make an already fine periodical increasingly interesting to the business aircraft pilot and owner.

ELI GRAUBART
Graubart Aviation, Inc.
Chicago 11, Ill.

More On Models

I was very pleased to see the story on the international Wakefield model airplane competition in the current issue of AVIATION WEEK (Oct. 1, p. 55).

Being in the model airplane business myself, I know at first hand that a great many pilots, engineers, mechanics, and production workers are devotees of this hobby, and that they often turn it to practical use. I'm sure that many of these are your readers, and that they, like myself, would appreciate additional coverage of this phase of aeronautics—particularly with the technical slant which your staff is so competent to give.

Incidentally, I have been a consistent subscriber to AVIATION WEEK and its predecessors for the past 26 years, and will tell anybody who cares for my opinion that it's the best book in the business.

GRENVILLE D. BRAMAN, JR.
American Telasco Limited
Huntington, N. Y.

Chilled By Show

The deflated, deteriorated, deglamorized fiasco called the National Aircraft Show left me cold.

Shades of Turner, Howard, and Doolittle, you call that a Thompson Trophy Race? It's not what I've been used to. The National Air Races used to be a slam-bang, rip-roaring affair with devil take the hindmost, not a sales counter for the hucksters and Armed Forces.

Why spend thousands of the taxpayers' money to demonstrate to the public that more thousands should be spent?

What these sad days of aviation need is a little of the old time glamor that civilian pilots always supplied through building their own aircraft and flying them in races.

While we're about it, let's set the cause of the demise of closed course racing straight—it was purely the fault of the show management (same now as in 1949) in allowing a pilot to fly who was not qualified in any sense of the word. He won the first race he ever flew in, but was killed in his second.

If the people running the show and making the profits want it all military, fine, it's good to make money. But let us then put the names Thompson & Bendix Races out to pasture along with OX-5 and not degrade the prestige of these names by further carrying on of a mockery.

SPECTATOR

Answer to Railroads

The Association of American Railroads, in a booklet quoted in your Sept. 17 issue (p. 41), urges the end of "preferential treatment" for the supplemental airlines. It is held that the railroads are placed at a disadvantage in competing for military traffic because irregular carriers are unrestricted by regulations and are aided by the Air Force in the form of "low-cost aircraft."

As you are aware, the idea that our branch of the industry is "unrestricted by regulations" is silly even for the railroad propagandists. The "irregulars" were nearly regulated out of business prior to last year's CAB decisions, which the railroads are trying to reverse in the courts.

Competition for military passengers is still on a price basis without reckoning of the value of men's time saved by flight as compared with ground travel, although the Defense Department and the Senate Appropriations Committee have stated that time should be taken into account.

It is not the airlines but the railroads that are free from regulation since they may file free or reduced bids on military traffic under Sec. 22 of the Interstate Commerce Act which the House Interstate Commerce Committee wanted to repeal last session.

As for the lease of military aircraft, only five transport-type planes were on lease to the supplemental air carriers from the Air Force and two from the Navy, according to a CAA compilation early this year. To our knowledge, no added military planes are being flown by these carriers. Earlier there were more planes on lease, but they were mostly recalled by the services or sold. Anyhow the carriers had to invest substantial sums in maintenance and improvements.

KENDALL K. HOYT
Director of Public Relations
Aircoach Transport Association, Inc.
Washington, D. C.

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ON THE GROUND . . . . incorrectly phased ground power could cause serious equipment damage.

LEACH'S ANSWER . . . 9243 Phase-Sequence Relay, which includes a 3-phase stall torque motor and control switches. Unless the predetermined phase sequence is applied at normal voltage, the relay will not allow the main contactor to close.

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LEACH'S ANSWER . . . . 9281, a combination of relay and magnetic amplifier, is sensitive to *250 microwatts,* is immune to shocks as great as 50 g. In addition it is compact and light.

ON COURSE . . . . gyro compasses drift if voltage input drops, but the back EMF they generate holds normal relays closed for 15-30 minutes.

LEACH'S ANSWER . . . 9267, Close-Differential Relay, a combination of magnetic amplifier, rectifier, and relay which warns the pilot of a drop in voltage. It is not affected by shock or vibration.

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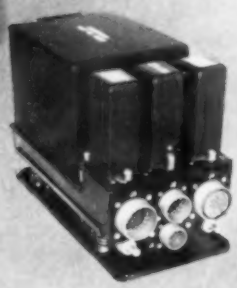

The Wind Drift Computer, conceived by McDonnell engineers and developed jointly with Servomechanisms' is typical of our Mechatronics design philosophy, which assures maximum reliability as well as minimum down-time through pull-out, plug-in replacement of the individual packaged functions.

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